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Sensibility and Climatic Pathology

The ill effects of bad weather appear often no otherwise, than in a melancholy and dejection of spirits, though without doubt, in this case, the bodily organs suffer first, and the mind through these organs.

EDMUND BURKE · *A Philosophical Enquiry into the Origin of Our Ideas of the Sublime and the Beautiful*

I have been lying on the sofa in a state of utter torpor. I mean to go out today to see if I am well or not. . . . If the present beautiful weather continues I shall be compelled to go and be happy in the country but at present I prefer being miserable in London.

ERASMUS ALVEY DARWIN · letter to *Frances Wedgwood*

MANY PEOPLE IN EIGHTEENTH-CENTURY Britain were concerned about the influence of the atmosphere on human health. A prominent aspect of the age's deepening interest in the weather was the question of how it affected bodily and mental well-being. The British believed that their climate had its characteristic virtues, but they also knew that the air sometimes made people sick. This susceptibility had been studied since ancient times, going back to the Roman physician Galen, and before him to Hippocrates, the supposed father of ancient Greek medicine. By the early eighteenth century, some of those compiling diaries of the weather were also beginning to record the prevalence of diseases in their localities. The new meteorological instruments of the period were used to investigate the physiological effects of temperature, moisture, and atmospheric pressure. In the late eighteenth century, a new instrument—the "eudiometer"—was introduced to

measure how breathable the air was. These inventions took the place of the seventeenth-century weather glasses, providing instrumental indicators of the human body's mysterious sensitivity to the qualities of the air.

There had long been individuals who saw themselves—or were seen by others—as especially vulnerable to the atmospheric environment. The Worcestershire diarist of 1703 is a good example of a self-identified "melancholic," whose valetudinarian anxieties made him particularly subject to the weather. In the late seventeenth century, such a person risked being labeled an "enthusiast." In the early decades of the eighteenth century, climatic susceptibility began to be seen as a more widespread social problem. People worried that more individuals were succumbing to aerial pathologies in the conditions of modern life. Melancholia was sometimes thought to be especially prominent among the British. Notwithstanding the national pride in the qualities of the air, it was acknowledged that the prevailing dullness and dampness could have a depressing effect on the spirits of the population. Medical writers also pointed to modern luxuries as causes of increased atmospheric susceptibility. Fashionable clothing, indoor entertainment, and the consumption of tea and coffee were all thought to be making people more vulnerable. It was believed that sensitivity to aerial maladies was increased by the debilitating effects of luxurious living. Apparently, the diseases of the air were also, to some extent, diseases of modern life.

In this way, climatic susceptibility came to be seen as an index of social and cultural change, another "barometer of Enlightenment." It was viewed as the unfortunate consequence of certain trends in British society, especially the cultivation of personal sensitivity in manners, moral behavior, and aesthetics. As a number of historians have noted, this period saw the rise of the "culture of sensibility."[1] In polite circles, a heightened sensitivity to the feelings of others and to the beauty of one's surroundings was validated and encouraged. The civilized individual was expected to have refined manners and fastidious tastes, and to be motivated by an empathy for his or her fellow creatures. Sensitive feelings were prized as the basis of morality and aesthetics, but they were also thought to make people vulnerable to the disturbing effects of their environment on health or mood. It might be admirable to feel deeply in response to literature and music, to respond emotionally to the sufferings of other people and animals, but it was all too easy for refined feelings to become a kind of pathology. People were thought to be getting sick because they had become too sensitive to the influence of things around them, including the air.

The issue of sensibility and its effects was both a moral and a political one. Some moralists regarded the indulgence of personal feelings as a lapse

of self-control, often characterized in gendered terms as a surrender of the masculine powers of reason to the feminine passions. For an individual, intemperance or self-indulgence could leave one vulnerable to diseases, including those originating in the air. Loss of rational control was also a problem for society at large, leading in the extreme to manifestations of mass enthusiasm, collective insanity, or religious frenzy. Writers such as Samuel Johnson and Thomas Short saw atmospheric susceptibility as a general loss of mental autonomy, portraying it as a sign of social corruption under the influence of luxury and soft living. For these conservative-minded commentators, climatic sensibility was indicative of the contemporary moral decline into laxity and effeminacy. It was a symptom of the decadence of modern society.

Others saw atmospheric susceptibility as a motivation for progressive social change. They went beyond merely studying the weather to trying to control it—at least as regards the quality of the air within and around human habitations. This air was to be improved to make it more conducive to health. Architectural schemes and projects for urban renewal strove to increase ventilation and the quality of the air people breathed. In the 1770s and 1780s, new techniques of "eudiometry" were used to assess the quality of the atmosphere. Discoveries in the chemistry of gases were exploited to yield new methods of treating the sick, sometimes yoked to quite radical schemes for enhancing the quality of the air at large. Those advocating reform often shared with conservatives the notion that civilization had brought with it a specifically modern vulnerability to atmospheric diseases by removing people from a natural mode of life. Even writers who were sympathetic to enlightened progress worried about these effects. But in seeking to alleviate them by projects of scientific therapeutics and comprehensive social intervention, the reformers parted company with the conservative moralists. They saw bad air as a challenge that demanded more systematic measures of enlightened reform.

Toward the end of the eighteenth century, atmospheric reform was being pursued in the spheres of individual therapy and social development. The leading reformers were advocating new modes of medical treatment, along with improvements in the environment and in the institutions of medical practice. Proposals to change the air became the centerpieces of wide-ranging programs of social reform. In the fraught political climate of the end of the century, these programs became very controversial. They were portrayed as expressions of rationalistic hubris and even satirized as a new kind of atmospheric pathology. But social programs of environmental improvement survived the century as a crucial component of the inheri-

tance of the Enlightenment. The eighteenth-century reformers of the atmosphere bequeathed to their successors a legacy of concern for the health effects of the air and a determination to address the problem by comprehensive social change.

The Hippocratic Revival

In modern times, Hippocrates has been described as a "name without a work," because the various texts ascribed to him since classical antiquity cannot be authentically connected with any historical individual.[2] In the eighteenth century, however, it was generally accepted that Hippocrates himself was the author of these writings, and stories about his medical accomplishments—for example, that he had halted the plague in Athens by having fires lit throughout the city—were widely reproduced. Central to the Hippocratic legacy was the idea that human diseases were caused by the physical environment and recurred regularly with the changing seasons. Works of the corpus, especially the *Aphorisms*, the first and third books of the *Epidemics*, and *Airs, Waters, Places*, traced the onset of disease to climatic conditions in the places affected. Physicians inspired by the Hippocratic tradition were supposed to be able to give advice on where were the healthiest places to live, paying attention to factors like the prevailing winds, the type of soil, the quality of the water supply, and the proximity of marshes and other sources of "bad air." They believed that if they knew enough about the normal conditions at a particular place and season, they could predict the diseases in the coming year. Illnesses—at least insofar as they were common in a population at a particular time and place—were viewed as products of the environment. Thus, the key to defeating them was the doctor's knowledge of the local climate and the pattern of its seasonal variations.[3]

By the eighteenth century, these core doctrines had been combined with other medical theories of ancient, medieval, and Renaissance origin. Galenic medicine recommended that people adjust their diet and regimen to their physical surroundings. Good health would result from achieving the right balance of what medieval writers dubbed the "non-naturals"—the circumstances that affected individual constitution, including air quality, exercise, sleep, nutrition, evacuation, and the passions. In the Renaissance, external macrocosmic influences were thought to bear upon the bodily microcosm.[4] The great sixteenth-century French jurist Jean Bodin grappled with the question of how the mind was affected by physical forces impinging on the body. He concluded that the soul itself, though "free

from all materiality, yet . . . is very much influenced by the closeness of the association" with its corporeal dwelling place.[5] Robert Burton's *Anatomy of Melancholy* (1621) agreed that the air's action on the mind occurred by the mediation of the body. Mental disorders like melancholy often went together with physical ones, according to Burton, both being brought on by the effects of bad air.[6] Edmund Burke's assertion in 1757 that depression and melancholy are caused by the atmosphere's influence on the bodily organs reflected the lingering hold of this classical tradition.[7] Emotional responses to the weather were taken as testimony to the sway of the bodily passions over the mind, reminders of the human intellect's lifelong imprisonment in the material body.

Because diseases were regarded as seasonal entities in the Hippocratic tradition, medical practitioners were supposed to attend to the astronomical markers of the calendar. The "dog days," the hottest of the year, associated with the rising of the star Sirius just before dawn, were supposed to be critical for many medical conditions. Although the Hippocratic texts did not countenance the idea that stars and planets directly affected diseases, many Renaissance physicians firmly believed in such celestial influences. Astrological interests led many doctors to try to match the daily progress of their patients' illnesses to the movements of the heavenly bodies. The weather was an obvious mediator of these effects for those who saw celestial influences at work in the atmosphere. In his letter to Samuel Hartlib, published posthumously in 1692, Robert Boyle proposed that the heavenly bodies caused sickness by affecting the properties of the air and its contamination by earthy effluvia. To study these effects, Boyle recommended the compilation of journals of the weather that would also record the motions of the heavens, "it being much more commendable for a Man to preserve the History of his own Time, . . . than to say, upon every Occasion that offers it self, this is the hottest, or this is the coldest; or this is the rainiest, or this is the most seasonable or unseasonable Weather that ever he felt; whereas it may perhaps be nothing so."[8]

Systematic recording of the weather was recommended to correct this sort of casual vagueness. Boyle believed that the daily journal would yield more reliable information about the atmosphere and lay bare its physiological effects. The same hope was shared by other members of the early Royal Society. John Locke appears to have undertaken his weather diary in the hope that it could be useful for medical purposes, though he did not chronicle incidents of sickness in the same journal. Robert Hooke's scheme for recording the weather called for compilers to make daily annotations of illnesses in their localities. Christopher Wren requested an annual report on

prevailing diseases from the physicians of the society, together with notes on the "difference of operation in medicine according to the weather and the seasons."[9] Thomas Sydenham, a leading London physician and friend of many members of the society (though never himself a fellow), began to note weather conditions in his records of diseases in the early 1670s. Sydenham became an influential advocate of the systematic, empirical approach to the subject. The development of his research showed how themes of the Hippocratic tradition were reshaped in light of the contemporary interest in diurnal changes of weather. He began in the classical Hippocratic mode by identifying seasonal patterns in the occurrence of "fevers" (by which he meant all acute, as opposed to chronic, conditions). Winter typically brought coughs, gout, measles, and smallpox, for example; spring yielded pleurisy and dysentery; summer brought cholera, scarlet fever, and smallpox again; and autumn would see rheumatism and the return of dysentery. Each season had its complement of "tertians" and "quartans," fevers that reached their peaks of intensity every three or four days, respectively. As he began to attend to daily changes of weather, Sydenham realized that the seasonal pattern would be interrupted by sudden alterations in atmospheric conditions, which could usher in diseases that were anomalous for the time of year. He distinguished "stationary fevers," characteristic of a particular season, from the "intercurrent fevers" that might interrupt them when the weather changed dramatically. Thinking along the same lines as Boyle, he speculated that changing weather conditions affected the atmosphere's capacity for absorbing the earthy exhalations that caused disease.[10]

Sydenham bequeathed to his many admirers and followers in the eighteenth century a set of issues for investigation and a technique for confronting them. Many subsequent medical writers were to ponder the relationship between the patterns of the British climate and the diseases that seemed to recur periodically in the population. They were also to try repeatedly to distinguish illnesses typical of a particular season from those that owed their origin to some unexpected alteration in the weather. The principal method of these inquiries, for many decades, was the combination journal of weather and diseases. In 1723, the physician and secretary of the Royal Society James Jurin published his general invitation to the learned world to submit meteorological records, expressing the hope that the project would advance medical knowledge. He received at least eighteen submissions, many by doctors, from as far away as Italy and Scandinavia.[11] A few years later, Francis Clifton recommended recording episodes of disease in the form of a table that would also include the weather. Clifton was a leading advocate for the Hippocratic method in the early 1730s, an

editor of the classical texts, the author of a history of medicine, and a leading member of the Royal College of Physicians of London.[12] The prominent London physician and man of letters John Arbuthnot, whose *Essay concerning the Effects of Air on Human Bodies* (1733) was the most widely read theoretical discussion of the atmospheric causes of disease, also called for the compilation of medico-meteorological journals. Hippocrates' plea for such research had not been heeded, complained Arbuthnot, but if it were, "a Piece of Knowledge, almost scientifick, might be founded, not incurious or useless to Mankind."[13]

Jurin, Clifton, and Arbuthnot provided significant encouragement for the Hippocratic project, which began to gain momentum in the third decade of the eighteenth century.[14] Hans Sloane published the journal he had kept in Jamaica back in the 1680s, and gave added authority to the medico-meteorological program through his presidency of the Royal Society from 1727 to 1741.[15] In slightly more obscure circumstances, and apparently independently of the metropolitan medical community, Clifton Wintringham, a physician at the county hospital in York, began in 1715 to record the weather and the diseases he observed in his practice. Wintringham explained the rationale for his enterprise by invoking the classical tradition, naming as inspiration not only Hippocrates and Galen but also the Roman physician Celsus and the philosophers Plato and Lucretius.[16] He continued his journal until 1734, publishing the record as a condensed narrative that surveyed a season at a time. Wintringham had obviously made instrumental measurements quite frequently, but in the published account he commented only on episodes when extremes of temperature or pressure were reached or when a dramatic change occurred. For each season, he gave a list of the diseases he had observed, remarking on the seasonality of certain illnesses and how they seemed to increase or diminish when the weather changed. In footnotes to the text, he groped toward explanations of these phenomena in terms of the physiological impact of changes in the atmosphere. Wintringham clearly understood that these tentative explanations were much less securely grounded than the basic factual data conveyed by his text. The narrative form of the journal was his solution to the problem of organizing these fundamental empirical facts, raw materials—as he hoped—for answering the Hippocratic questions of how diseases changed with the seasons and the more rapid fluctuations of the British weather.[17]

All investigators faced the difficulty of finding a form of writing that would allow these questions to be addressed. In 1741, Roger Pickering presented a plan to the Royal Society for incorporating records of diseases in a

tabular weather register. The aim was to find out more about the national propensity to certain illnesses, to guard "against the Disorders, which, as *Islanders*, we are exposed to."[18] Pickering, a country vicar who also wrote an essay on mushrooms in the *Philosophical Transactions*, proposed that the standard columns for temperature, pressure, rainfall, and so on be supplemented with one giving figures for the causes of deaths drawn from the weekly bills of mortality. His scheme has been shown by Andrea Rusnock to mark a significant step toward the compilation of social statistics.[19] But statistical tabulation did not displace narrative description, and most researchers continued to rely on their own encounters with those suffering from diseases rather than on published figures. As Pickering put it, scientific knowledge "must arise from a Variety of Observations, made by different Men of Application and Judgment."[20] Printed tables were often used for recording instrumental readings, but most observers thought it more appropriate to give verbal narratives when it came to recounting their personal experiences with patients.

John Huxham, a physician in practice in Plymouth, was encouraged to start keeping a medico-meteorological journal by Jurin in the mid-1720s. Huxham had interests in natural history and astronomy as well as in many aspects of medicine; he used a barometer and a thermometer supplied by the London instrument maker Francis Hauksbee to begin his weather journal in 1724. A few years later he started to record illnesses, adopting the form of a month-by-month narrative in which he passed from remarks about the weather to comments about the diseases he had encountered. Like Wintringham, he noted extremes of air pressure, temperature, or rainfall, or occasions when a sudden change had occurred. He paid particular attention to the wind's direction and when it altered; he recorded mental conditions—low spirits, melancholy, lunacy—along with the physical ailments that afflicted local people.[21] A very similar approach was adopted by William Hillary, also a physician, who began his record just about the same time, at Ripon in Yorkshire. Hillary kept up his journal from 1726 to 1734, when he moved to Bath. Later, he resumed his inquiries in Barbados, to which he emigrated in the early 1750s.[22] Hillary produced a continuous narrative, punctuated sometimes by months and sometimes by seasons. Though he had evidently used instruments, he gave few readings of thermometer or barometer; but he did note episodes when they changed abruptly. Sudden alterations in the weather were especially remarked when they coincided with the emergence or disappearance of diseases. The episodic narrative form allowed Hillary to recount these incidents as it were historically, suggesting by the construction of his prose a connection

between the atmospheric causes and the pathological effects to which they were thought to give rise. He packed into the narrative framework details about symptoms and the effectiveness of particular therapies, and he was able to mention individuals who, because of their peculiar constitutions, were exceptions to the general trends. A typical paragraph from his years in Yorkshire ran as follows:

> The State of the Weather continued much the same till about the middle of *March* 1728, when the Barometer which had risen a little before, now fell again, as did the Thermometer also, and we had great and almost continued Rains for three Weeks, with cold North Winds, and sometimes Snow: Upon which the above-mentioned Inflammatory Diseases, *viz*. Pleurisies, Peripneumonies, Quinseys, and some Rheumatisms, increased both as to the Number of the Sick, and the Violence of their Symptoms; the Pleurisies and Peripneumonies were some of them of the true, and others of the nothous [spurious] Kind; the Pulse was generally low, but very quick and hard, the Pains acute, the Blood very sizy, and cover'd with a thick buff-like Pellicle; the Sick were not relieved without often repeated Bleeding, diluting plentifully with Emollients and Pectorals, and Volatiles added to them. Those who before had suffered much from the Intermittent in the Winter, were most liable to be seized with these Disorders; and as they could not bear the Loss of much Blood, many of them died.[25]

At the end of his record, Hillary added a series of "aphorisms," drawing preliminary—and admittedly speculative—conclusions from his observations. His comments indicate how the Hippocratic program had been reinforced, in the decades before he wrote, by concepts derived from the iatromechanical tradition of the seventeenth century, which understood the workings of the human body in terms of the mechanical operations of fluids and solids. Wintringham, Arbuthnot, and others drew upon the same theoretical vocabulary in their accounts of the effects of atmospheric conditions on health. Hillary suggested, for example, that hot weather relaxed bodily fibers but reduced their elasticity, and that it led to the volatile parts of fluids being excreted in perspiration, leaving the thicker and less mobile parts behind. The result would be obstructed circulation, inflammations, and fevers. Cold, on the other hand, contracted the fibers, reducing the speed of circulation and the release of noxious matter by perspiration. Changes of weather conditions thus removed the causes of certain diseases but tended to give rise to others. Rapid changes of conditions would be hazardous for

everyone, particularly for those with more susceptible constitutions. Hillary concluded that, from his observations, "the Reasons will appear, Why temperate, moist and gradually variable Weather is most healthful: Why sudden Changes of the Seasons are, on the contrary, most sickly: And, Whence it is, that each Season, if it observes its common Course, is attended with Disorders peculiar to itself." [24]

Hillary's work showed what a perceptive and thoughtful observer might accomplish working within the eighteenth-century Hippocratic tradition. The new awareness of weather as a quotidian phenomenon was concentrating people's attention on the often rapid changes of conditions that were typical of the national climate. It sometimes seemed that the only constant thing about the British weather was change. This being so, the traditional Hippocratic focus on the seasonality of diseases required some modification in the circumstances. Hillary knew that each season would produce the normal complement of diseases "if it observes its common Course." But in order to determine if the season was typical, it was necessary to keep track of conditions on a shorter timescale, such as the diurnal one of the daily journal. This was the procedure generally adopted among the British devotees of Hippocrates, who then faced the problem of trying to discern a pattern of connections between abrupt changes in the weather and the ups and downs of diseases in individual patients or in the population as a whole. In 1733, the prominent physician George Cheyne commented that the standard cyclical patterns that were supposed to govern the development of diseases, identified by Hippocrates in the calm and settled conditions of the Mediterranean, were hopelessly confused "in this various and inconstant Climate." [25] Forty years later, John Rutty, drawing upon his own long experience in Dublin, agreed that trying to correlate the weather of the British Isles with the progress of diseases was as hopeless as fixing a sundial on a weathercock.[26]

Notwithstanding the difficulties, compilers of medico-meteorological journals continued their efforts. Rutty himself incorporated notes on the prevailing diseases in his record of the weather in Dublin from 1725 to 1766. He claimed to have kept his journal continuously, but he worked it up for publication into a narrative covering a month at a time. He knew the work of Wintringham, Huxham, and others, and concurred with the consensus view that the perennial dampness of the British Isles, with its temperature oscillating seasonally between moderate warmth and moderate cold, produced constant "endemic" ailments, including a fever of "a low putrid kind." [27] Likewise, Rutty agreed that each season had its own complement of illnesses. In addition, temporary epidemics swept across the land, frequently

FIGURE 16 · Frontispiece to the *Gentleman's Magazine* 21 (1751). This plate introduced the volume of the *Gentleman's Magazine* in which John Fothergill's weather diaries first appeared. It shows Asclepius having laid down his rod entwined with a serpent to consult a barometer. Courtesy of Special Collections, Dimond Library, University of New Hampshire.

coinciding with abrupt changes of weather. Rutty used published accounts from London, Edinburgh, and other locations to map the progress of these. John Fothergill's monthly accounts of the weather and diseases in London, published in the *Gentleman's Magazine* from 1751 to 1754, adopted a similar approach. He made use of his instrumental record to tabulate the extremes of temperature and pressure in each month, and also the greatest change of these variables in any single day. Both factors were significant because, according to Fothergill, "not only a steady course of any kind of weather may produce particular diseases, but likewise very quick transitions from one extreme to another may be equally injurious." [28]

Everyone studying the subject seems to have agreed on what they were looking for: on the one hand, recurring patterns of seasonal ailments, and on the other, the impact of sudden changes in weather conditions. Most authors claimed to have found such patterns among the patients they were acquainted with, but it proved difficult to generalize the conclusions in any satisfactory way. In 1762, Charles Bisset tried to summarize the consensus in his *Essay on the Medical Constitution of Great Britain*, and he found himself harshly criticized for the attempt. Bisset was an Edinburgh-educated physician who had served as an army surgeon in the West Indies and North America and as a military engineer in the Low Countries before settling into private practice in Yorkshire. He began his essay with remarks that reflected the consensus about the British climate, noting that its temperateness and moisture were usually healthy features, while "the native prevailing diseases in this Island [are] in general generated, and excited, by the frequent changes of the weather peculiar to Great Britain." He went on to catalogue the ailments typical of each season, noting that anomalous illnesses were always liable to be introduced by unseasonable weather and sudden alterations in the air. Resorting to iatromechanical reasoning of the kind that was typical of the Hippocratic writers, Bisset suggested that the effects of moisture and moderate cold strengthened the fibers and overall fabric of the body, so that "the natives of Great Britain, in general, are bigger bodied, broader chested, and more robust, than those of most other countries." Vulnerable though they were to colds, rheumatism, and certain fevers, the British people could be assured that their climate was basically a healthy one, and that "epidemic diseases of great malignity are much greater strangers in this island, than in most countries on the continent." [29]

Bisset probably did not anticipate criticism for these fairly anodyne variations on the providential interpretation of the British climate. Like many other authors, he was telling his co-nationals that although they were vulnerable to certain airborne illnesses, things could have been much

worse, and indeed they were in other countries. He was fiercely taken to task, however, by a writer for the periodical *The Critical Review*, edited by the novelist and physician Tobias Smollett. The reviewer (probably Smollett himself) claimed that Bisset had overemphasized the seasonal character of British ailments, applying a system that "might be proper in a country that enjoys a regular succession of seasons, with sure and settled tracts of weather," but that was inappropriate for "Great Britain, where the transitions from one extreme to another are so sudden and irregular." Bisset was also said to have erred in his optimistic view of the healthy qualities of British rain. The reviewer maintained that "if we may trust to our own observation, a rainy winter is, of all winters, the most unwholesome; nay, it is proverbially so."[30] Bisset was stung by the criticism, especially by complaints about the tedium of his prose style and its contamination by crude Scottish expressions; he felt obliged to defend himself by bringing out a pamphlet in response.[31] But, considered from a distance, the dispute reveals not so much fundamental differences of outlook as the basic assumptions of the Hippocratic tradition, which were common to Bisset and his critical reviewer. Both held that the atmospheric environment was a primary cause of prevailing diseases; both attempted to understand this in iatromechanical terms of the influence of heat and humidity on bodily fibers and fluids. Both believed that seasonal variations and the more abrupt changes of weather had effects on the occurrence of diseases, though they tended to give different degrees of emphasis to the two factors. And both operated within a providential framework in which the British climate was generally thought to be good for people—although, as physicians, they were obviously well aware that sickness and death were unavoidable, and to that extent they acknowledged that all could not always be for the best.

These were the leading themes of the Hippocratic tradition as it took root in eighteenth-century Britain. Newly conscious of the quotidian character of their weather, British investigators from Sydenham onward realized that the traditional Hippocratic emphasis on the seasonality of diseases required some modification. Most observers recognized seasonal patterns in the occurrences of particular ailments, but they also pointed to the impact of more rapid changes of atmospheric conditions—the daily fluctuations typical of the British weather. To trace the effects of these on patterns of sickness required constant monitoring, and the compilation of medico-meteorological journals seemed the appropriate way to approach the problem. With some variations of form, these continued to be written throughout the century. Thomas Short, though he sometimes expressed skepticism about the value of these records and turned to the methods of

social statistics later in his career, kept his own journal in Sheffield for nearly thirty years.[32] In the 1770s, Dr. John Bayly in Chichester, Sussex, was adding copious medical notes to his painstaking monthly records of the weather and expressing confidence that eventually, "ye Causes of Diseases may be rationally deduced from ye manifest Qualities of ye Air."[33] At the end of the century, yet another provincial doctor, Thomas Hughes from Stroud in Gloucestershire, was recording occasions when "many cough at church" on Sundays, gauging the health of his neighbors as meticulously as he measured air temperature, pressure, and humidity with his meteorological instruments.[34] Hughes was working in a tradition of inquiry that was, by his day, already more than a century old. Like his many precursors, he was seeking ways to grasp the variables of weather and disease, convinced that Hippocrates had been right to suppose that the climatic environment had an important bearing on the health of a population. For British investigators, the Hippocratic perspective suggested that changes in weather conditions would cause particular illnesses to emerge. Prolonged investigation and direct personal observation were thought to be necessary to uncover these coincidences. Notwithstanding the efforts of many dedicated inquirers, however, the temporal scales of atmospheric and pathological events proved impossible to reconcile, and the connections between weather and disease continued to elude definitive specification.

Aerial Sensitivity and Social Change

In *The Spectator* of 25 July 1712, Joseph Addison offered his readers an account of "a Sett of merry Fellows, who are passing their Summer together in the Country." The group was said to be residing in a substantial house, which, along with apartments for all of the company, contained an infirmary "for the Reception of such of them as are any way Indisposed, or out of Humour." As the story unfolds, the members succumb one by one to bad temper, melancholy, or some other condition that manifests itself in antisocial behavior, and are dispatched to the infirmary. The narrator speculates in a Hippocratic vein about how immoderate diet or inclement weather might have led to this epidemic of indisposition. In this setting, readers are introduced to the figure of the "human barometer." One of the company having announced to the rest that "he knew by a Pain in his Shoulder that we should have some Rain, the President ordered him to be removed, and placed as a Weather-glass in the Apartment above-mentioned."[35] Addison's satirical sketch evoked the seventeenth-century weather glass, which, as we saw in the previous chapter, was often likened to the human body in its

responses to changes in the air. By the beginning of the eighteenth century, the barometer had begun to take over this role. It displayed the physiological effects of the atmosphere and reminded people that the human body itself could be considered a kind of instrument. People who manifested a heightened sensitivity to the air's qualities, or said that they could tell when the weather was going to change, became known as human weather glasses or human barometers.

When the barometer was still quite new, researchers insisted that it displayed properties of the air that were physiologically significant, even though they sometimes disagreed about what those properties were. In 1673, Boyle wrote that he was "prone to suspect" that alterations in atmospheric pressure could affect human health.[36] Martin Lister, who had a theory of the barometer quite different from Boyle's, thought that the device indicated the effects of the air on the bodily humors.[37] John Smith and Richard Neve, early writers on the instrument for the general public, held that it showed the atmosphere's influence on the body. As Smith put it, "The lower the *Quicksilver* descends, the more listless and out of order Men's Bodies are." When the mercury level was high, on the other hand, according to Neve, "Men's Bodies are then found to be more Brisk and Lively."[38] John Arbuthnot described the medical consequences of changes in air pressure in his influential essay of 1733. He wrote that he had "observ'd very sensible Effects of sudden falls of the Mercury in the Barometer in tender People, and all the Symptoms they would have felt by the Exsuction of so much Air in an Air-Pump." Susceptible individuals, according to Arbuthnot, experienced "lypothymies" during sudden drops in air pressure, undergoing convulsions like the mice and birds Boyle had sacrificed in his air pump.[39] In 1750, Thomas Short summarized what was by then a medical consensus. In conditions of high pressure, Short wrote, "we find ourselves brisk and lively, from the greater Velocity of the Blood, and fuller and juster Discharge of all natural and necessary Secretions and Evacuations." Excessively high pressure, however, posed risks to health, tending to bring on such illnesses as pleurisy, pneumonia, and hot fevers. Low air pressure was equally hazardous, causing a dangerous diminution of circulation and perspiration that could induce hysteria, nervous disorders, and putrid fevers.[40]

Concern about barometric pressure did not exclude awareness of the dangers posed by other factors in the aerial environment. In fact, atmospheric pressure diminished as a preoccupation of medical writers later in the century, as discussion of the perils of tropical climates increased. In the tropics, heat and humidity seemed to be the most pressing dangers to the health of British soldiers and settlers. But medical opinion agreed that

the changes revealed by the barometer were physiologically significant, especially if they were rapid and of large magnitude. Thus, barometers, along with thermometers, hygrometers, and wind gauges, became part of the instrumental armory of researchers recording the fluctuations of weather and diseases. Wintringham used the barometer and thermometer while compiling his record in York for almost two decades. Huxham used both instruments and a hygrometer for his *Observations on the Air and Epidemic Diseases* (1739). Hillary observed the barometer for nine years in Yorkshire and then for a further six in Barbados. John Phelps's satirical poem *The Human Barometer* (1743) reflected the general view of the time that high pressure was good for circulation and vivacity, while low pressure led to languor and melancholy. Use of the barometer had made people aware of a new dimension of climatic sensitivity, showing them that their bodily health was vulnerable to the environment in a previously unsuspected way.

Phelps's poem also spoke to widespread moral concerns about atmospheric sensibility. The notion that large numbers of individuals were succumbing to environmental illnesses was a worrying one for many commentators. It suggested that the circumstances of modern life might be responsible, either by aggravating the noxious qualities of the air or by weakening people's resistance to its effects. Increased susceptibility was often thought to flow from moral failings, such as intemperance or indulgence in luxury or soft living. Phelps explained in the prose prologue to his poem that moral and physical health alike depended on the mind's control over the impulses of the body. The union of body and soul, he explained, is "so intimate tho' inexplicable" that each was profoundly influenced by the state of the other. Virtue demanded "the proper Exercise of the rational Faculties, to maintain a regular and watchful Government" over the impulses of the body, so that they did not prejudice one's health.[41] Illness, according to Phelps and others, could be a sign of moral weakness. Those whose health suffered from the effects of the air were suspected of being partly responsible for their own condition, having given in to their passions or weakened their constitutions through intemperance.

Phelps sketched some of the unfortunate social consequences that could follow from these lapses of self-control. He compared two instances of extreme mental derangement: the madness of the inmates of Bedlam, London's notorious lunatic asylum, and the religious fanaticism of followers of the Methodist preacher George Whitefield, who was renowned for his ability to mesmerize his audiences. Whitefield was presented as preaching just outside the walls of Bedlam, evoking from his hearers the same kind of frenzied behavior found among the inmates of the institution.

There mounted on his Tripod *Whitefield* stands,
Silence and Awe canonick Garb commands,
With Arm extended see he apes *Saint Paul*,
And counts his own an Apostolick Call,
Gesture and Voice betray the heated Brain
In Groans his Converts echo back again,
And Souls impress'd with Thoughts of Grace, or Sin,
Expectorate their Sense in solemn Din.
These of enthusiastick Transports boast,
But are to Argument and Reason lost.[42]

With the mention of "enthusiastick Transports," Phelps reminded his readers of the associations surrounding the highly charged term *enthusiasm*. Since the mid-seventeenth century, "enthusiasts" had been portrayed as in the sway of their own dangerous passions, claiming religious authority for what were actually mental disturbances caused by vapors rising into the brain. Henry More wrote in 1662 that enthusiasts were inspired by "nothing else but that *Flatulency* which is in the *Melancholy* complexion, and rises out of the *Hypochondriacal* humour upon some occasional heat."[43] In this way, religious fervor was classified as a kind of sickness; fanaticism—with its destabilizing social consequences, so painfully evident in the conflicts of the seventeenth century—was "medicalized."[44] In Phelps's poem, the seventeenth-century enthusiast was reincarnated as the eighteenth-century human barometer. Climatic susceptibility emerged as a kind of surrender to the passions, closely allied to melancholia, hypochondria, and enthusiasm, and raising similar worries about its potential antisocial consequences.

The concern about these conditions in the early eighteenth century was heightened by trends that seemed to be encouraging people to be more sensitive to their surroundings. What has been called the culture of sensibility was manifested in new attitudes and behavior that were becoming prevalent among the British middle classes by the middle of the century. Polite manners were supposed to be accompanied by refined feelings, shown by an individual's aesthetic responses and sympathy for other people and animals. Philosophers, following the lead of the third earl of Shaftesbury, argued that sympathy was an expression of an inherent "moral sense," which was the basis for telling right from wrong and acting accordingly. Good taste was also said to derive from inherent feelings; people were thought to have a capacity to recognize beauty when they encountered it. Such sentiments were natural, but they also had to be cultivated. Politeness was

FIGURE 17 · William Blake, "Air — on Cloudy Doubts & Reasoning Cares" (1793). Blake's sketch evokes the traditional association of melancholy with cloudy weather. © Copyright Fitzwilliam Museum, University of Cambridge. Reproduced by permission.

identified with the refinement of one's inherent feelings as guides to what was good in morals, manners, and the arts. With the spread of these attitudes, more considerate behavior came to be expected of individuals, and more emotional responses to literature, art, and music became common. As G. J. Barker-Benfield has shown, these developments had important effects on the relations between the sexes in the period. Middle-class men tended to abandon cruel sports and rough behavior, turning to the cultivation of manners and emotions previously associated with women. The figure of the man who had gone too far in this direction and had become foppish or effeminate was a stock character for satire in novels and drama.[45]

Medical writers worried that the culture of sensibility was bringing with it a tendency to a certain kind of pathology. Sensitivity, it was feared,

could readily become *too* developed; refinement or delicacy could tip over into debility or illness. *The English Malady* (1733), by the charismatic and eccentric doctor George Cheyne, was a harbinger of this concern. Cheyne, a Scottish physician who made his fortune in practice in London and Bath, regarded nervous sensitivity both as an attribute of intellectual and social refinement and as a disposition to ill health.[46] Enhanced sensibility could all too easily lead to nervous disorders, as those of refined manners or cultivated intellect frequently found to their cost. Some of the causes of this were general to the British nation, according to Cheyne. He pointed to the climatic situation of the island at the edge of an ocean, with its moist air and variable weather. More important were the social and economic trends that had increased luxury and encouraged self-indulgence. Cheyne condemned such modern habits as eating food flavored with rich sauces, riding in smooth coaches, and living in crowded cities. His contemporaries were putting their health at serious risk by indulging in this kind of pleasure. They should take a lesson from the ancient Greeks, who had found that "in Proportion as they . . . distinguished themselves from other Nations by their Politeness and Refinement, they sunk into *Effeminacy, Luxury*, and *Diseases*, and begun to study *Physick*, to remedy those Evils which their Luxury and Laziness had brought upon them."[47]

Cheyne's anxiety about the diseases of modern life was very influential. He highlighted for his contemporaries concerns about the medical damage wrought by the ease and affluence of civilized society. The English malady—which Cheyne identified particularly with nervous disorders such as hypochondria, hysteria, and melancholia—came to be seen as an expression of the country's prosperity and the excessive sensitivity it had spawned. Like other medical writers, Cheyne was confident that the remedy for these ills was temperance: a moderation of consumption in all respects, a return to natural foods, vigorous exercise, and clean living. He identified temperance with virtue and was convinced that virtue would be rewarded by good health and happiness. Although in this respect he shared the providentialist assumptions of his contemporaries, he also gave expression to an underlying anxiety. He suggested not only that the British climate was less than perfectly conducive to the wellness of the population, but that specific aspects of the modern lifestyle were making things worse. He pointed to the dangers of living in a congested city like London, where the smoke of fires and candles, human breath and perspiration, the ordure of animals and people, and the effluvia of graveyards, slaughterhouses, and dunghills were "more than sufficient to putrify, poison, and infect the Air for twenty Miles round."[48] The risks posed by such development should

not be ignored. As far as Cheyne was concerned, those who looked to seasonal fluctuations to explain outbreaks of disease were missing the much more serious impact of contemporary social changes.[49] The Hippocratic model, rooted in the placid climate of the classical Mediterranean, was not really applicable to modern Britain, where nervous disorders were more prevalent because people's sensitivity had been increased by the contemporary environment.

Cheyne did not view the atmosphere as the only source of modern maladies, but his concerns fed into the enterprise that was searching for the aerial origins of disease. The idea that modern life was increasing people's pathological susceptibility qualified some of the prevailing complacency about the benefits of the national climate. On the one hand, the optimistic view was that the British population was blessed with just the right degree of nervous sensibility, with positive consequences for their civilization and even their political liberties. The physician William Falconer argued that their natural sensitivity made them good at friendship, respectful of the rights of women, sympathetic to the plight of the less fortunate, strong in the defense of their independence, and fond of animals. The British, he asserted, owed their social sentiments to their climatic situation. As inhabitants of the temperate zone, they were able to tame their feelings and direct them to the ends of civilized society. Their emotional stability allowed them to experience the benefits of collective life while rejecting authoritarian tyranny. Had they lived further north, they would have been brutal and antisocial, like the inhabitants of the polar regions; further south, the hot passions of the tropics prevailed, which were equally destructive of social harmony.[50] As the Scottish historian William Robertson wrote, it was only in the temperate region of the globe that mankind "possesses a superior extent of capacity, greater fertility of imagination, more enterprising courage, and a sensibility of heart which gives birth to passions, not only ardent, but persevering."[51]

On the other hand, however, there were those who worried that this emotional stability was slipping away and that sensibility was running out of control. Samuel Johnson seems to have thought that to admit that the weather could affect one's health or mood was to submit the powers of the mind to the sway of the passions. In *The Idler* for 24 June 1758, he complained that "surely nothing is more reproachful to a being endowed with reason, than to resign its powers to the influence of the air. . . . To call upon the sun for peace and gaiety, or deprecate the clouds lest sorrow should overwhelm us, is the cowardice of idleness, and the idolatry of folly."[52] Johnson thought his contemporaries were far too willing to indulge their

atmospheric susceptibilities; he repeatedly told James Boswell in conversation that it was foolish for people to say that the weather affected their feelings. He also denied that his massive consumption of tea influenced him emotionally, though some doctors blamed the beverage for increasing people's vulnerability to atmospheric ailments.[53] For Johnson, keeping control of his reasoning powers was a point of pride, and the fear of losing them was a source of great anxiety. He suffered severe and repeated bouts of depression, dreaded that he was going mad, and prayed frantically that he would not lose his mind. He had no time for the fashionable notion that a melancholy disposition was a sign of artistic genius; for him, it was simply a source of acute suffering, compounded by the dread that it might foretell a complete loss of mental control.[54] Given these preoccupations, it is not surprising that Johnson regarded with stern disapproval the tendency among his contemporaries to submit themselves to the qualities of the air.

For Johnson, the issue of climatic sensitivity was a highly personal one. Other writers of a conservative or moralistic inclination emphasized how it was symptomatic of undesirable trends in their society. They saw many of the new fashions of the time as examples of indulgence and intemperance that would surely weaken people's resistance to airborne maladies. Wintringham remarked on the unhealthy quality of urban air and the debilitating effects of drinking tea and coffee, "so much in Use among the Ladies."[55] Short and Fothergill shared his view that excessive consumption of tea could make people more vulnerable to atmospheric diseases. Hillary, after emigrating to Barbados in the 1750s, castigated the European residents there who were so in thrall to fashion that they wore clothing much too heavy for the hot climate and contracted a variety of diseases as a result. He lamented that "Fashion and Custom are two prevailing Things, which inslave the greatest Part of Mankind." The predilection of European women for dancing also attracted his reproach, though he acknowledged that "most of the Ladies are so excessive fond of it, that say what I will they will dance on."[56]

Much of the criticism was directed at women's behavior, a perennial target of moralistic censure under the cover of medical advice. Arbuthnot identified as particularly unhealthy the unventilated rooms in which "People of Fashion pass a great deal of their time." "Ladies and other tender People," he noted, suffered the effects of air "tainted very much with the Steams of Animals and Candles."[57] New fashions and manners among women were always liable to attract men's disapproval, since they challenged male authority. But the yoking of women with other "tender people" and "people of fashion" suggests that the targets of criticism were more general and the issues at stake more specific to this context. Climatic

susceptibility was thought to be symptomatic of an overall process of softening or effeminacy, which was believed to be affecting men as well as women in eighteenth-century Britain. The critics were fastening on general developments in the society around them: the accelerating cycles of fashion, the increase in material affluence or luxury, the consumption of new foodstuffs and drinks, and the tendency to refined manners, emotional expression, and aesthetic sensitivity. All seemed to reflect the attenuation of masculine identity in the face of a feminization of character and mores.[58] And all were represented as increasing the population's risk of succumbing to diseases, including those originating in the air.

Thomas Short's work in the 1750s and 1760s shows how medical discourse was influenced by these moralistic concerns. Around the middle of the century, he began to compile statistics to try to answer questions about the health effects of climate and the local environment. This culminated in *A Comparative History of the Increase and Decrease of Mankind* (1767), a pioneering work of social statistics, in which Short used the bills of mortality to deduce which places in England and other countries had the healthiest soil, water, air, and other conditions of life.[59] Overall, he concluded that healthy locations were dry, on mountains or rocky soil, while unhealthy ones were wet, low-lying, and swampy. In addition to these physical factors, his analysis devoted considerable attention to social conditions like legislation and prevailing moral standards. He was reflecting the debate (to be discussed in the next chapter) in which David Hume and others had responded to the ideas of the Abbé Du Bos and the Baron de Montesquieu, distinguishing the "moral" from the "physical" causes of longevity and population growth. When he contemplated the notoriously high mortality rates in London, Short turned to moral causes to explain them, pointing out the frequency of prostitution and intemperance in the capital. Promiscuity, according to Short, decreased human fertility, as did excessive consumption of liquor. Firm measures were required by legislators and magistrates to suppress this kind of vice and promote virtue, in order to ensure the health of the population.[60]

Striking this moralistic note, Short echoed the works of his medical contemporaries and predecessors, including Cheyne, Arbuthnot, Wintringham, and Hillary, who viewed susceptibility to atmospheric diseases as symptomatic of moral weakness. He shared their concern about the fashions of modern life that had increased the prevalence of this aerial sensibility. He also, however, endorsed more concrete programs of environmental improvement, which were being pursued in the second half of the eighteenth century. Short stressed that it was possible to take practical

steps to "mend the air." He mentioned improving the ventilation of houses, draining marshy areas near settlements, removing human and animal excrement, and other measures. Initiatives of this sort were commonly endorsed by enlightened reformers and were implemented to some extent in the latter part of the century. They were to take the project of atmospheric medicine, which had emerged from the Hippocratic revival of the late seventeenth century, in a new—and at times quite controversial—direction.

The Politics of Atmospheric Reform

The revival of the Hippocratic tradition posed problems for the providential interpretation of the British climate. Medical practitioners tried to determine if the familiar fluctuations of the island's weather were healthy or unhealthy for the population. Did they confer the benefits of a stimulating variation, as was suggested by some authors, or did they expose people to a constant succession of new diseases, as classical tradition might lead one to expect? More fundamentally, the question of climatic susceptibility raised pressing moral concerns surrounding the relations between the physical environment and the progress of civilization. Some writers developed the providential line, arguing that the British people owed to their climate a moderate and socially beneficial degree of sentimental feeling, while others suggested that the population was being put at risk of airborne and other diseases by a sensibility accentuated by the conditions of modern life.

Among these conditions were the circumstances of urban existence, increasingly registered as hazardous to the health of those who lived in London and other large towns. Many commentators expressed anxiety about the unhealthiness of urban spaces, the air polluted by the effluvia of so many people and animals, their carcasses, rubbish, and bodily wastes. Rutty's complaint about the air in Dublin in the early 1770s was typical. He pointed to

> the fogginess from the smoke when there is no wind to dissipate it, the dirtiness of our streets, which is so great that one is frequently in danger of being up to the knees in crossing them, the putrid animal effluvia exhaling from Charnel-houses and dunghills in the middle of the city and in several of the avenues, and dead animals, dogs and cats and the excrements of living ones, butcher's garbage and blood, and burying grounds likewise in the middle of the city, where the earth, in the graves, is frequently so loose and the bodies so near the surface of the ground, that the scent has been noxious in a hot summer.[61]

The Hippocratic tradition of medical thought made these atmospheric dangers seem particularly pressing. Members of the polite classes believed their enhanced sensibility was making them more vulnerable to the effects of such contamination. At the same time, they prided themselves on a refined sense of smell that brought them warning of the perils. Projects to improve the quality of the air unfolded against this background, using foul odors to identify sources of unhealthy airs and intervening in the environment to remove them. The early part of the century saw attempts to bring healthy air into the places where people lived or worked, initially in small-scale projects to ventilate buildings, mines, and ships. Within a few decades, more ambitious proposals were being made. The urban atmosphere was to be comprehensively improved by programs of environmental amelioration and social engineering. Stagnant water was to be drained, cemeteries cleared from urban centers, sewage and wastes removed, and streets widened to allow for the circulation of air.[62] Discoveries about pneumatic chemistry and the mechanism of respiration encouraged the advocates of these proposals. Researchers believed they could distinguish "good" from "bad" air by chemical tests; they assumed a single scale of aerial quality, identifying the healthiness of the air with the absence of foul smells. The goodness of the air was thus associated with moral virtue, reflecting the values invested in hopes for atmospheric improvement. The advocates of improvement held that good air was naturally conducive to good health, while bad air was the product of combustion, putrefaction, and death. They believed that progress would come from exploiting the benevolence of providence to offset the effects of atmospheric corruption, supplying people with the air that was good for them while removing that which was bad.[63]

A prominent pioneer of pneumatic chemistry and atmospheric improvement in Britain was Stephen Hales, curate of Teddington in Middlesex from 1709 until his death in 1761. Hales was known for his investigations of animal and plant physiology and for developing methods to collect quantities of air released by chemical reactions or the processes of life. He did not chemically differentiate the kinds of air he collected; instead, he focused on the physical property of expansiveness that they all shared. This, he believed, was the key to the role of airy substances in the providential economy of nature, a universal system sustained by the balance between repulsive and attractive forces among particles of matter. Hales believed providence must have provided means to restore the natural expansiveness of air after the vitiation caused by combustion or respiration, though he did not know what these mechanisms were. He therefore stressed the importance of human intervention to bring good air to where it was needed in

order to replenish that which had been exhausted. This was the motivation for his design of a machine for ventilating ships' holds, prisons, and hospitals. The need for fresh air was particularly urgent, according to Hales, where the atmosphere had been tainted by combustion, putrefying matter, diseased persons, or the bodies of the dead.[64]

The general conception of an economy of good and bad air, and the association of bad air with putrefaction and disease, continued to feature in the development of pneumatic chemistry by Hales's successors. Sir John Pringle was particularly influential in encouraging work on atmospheric improvement in the three decades after 1750. Having resigned a medical professorship at Edinburgh, Pringle served for a while with the British army in Flanders in the late 1740s. His *Observations on the Diseases of the Army* (1752) drew attention to the dangers of establishing field hospitals and camps near the putrid air of marshes. In line with the Hippocratic tradition, he traced the onset of epidemics to meteorological conditions, but he also advocated vigorous intervention to change the air surrounding sites of habitation. To deal with scurvy—then a scourge of the Royal Navy as it tried to extend its influence across the world's oceans—Pringle recommended ventilation of ships and the consumption of certain "antiseptic" substances, such as fermenting vegetables and the "fixed air" (carbon dioxide) recently studied by the Glasgow chemistry professor Joseph Black.[65]

Pringle also supported the work of the Dissenting minister Joseph Priestley, whose pneumatic researches of the early 1770s yielded dramatic new resources for studying varieties of air and putting them to use. In 1772, Priestley—then a minister at the Mill Hill Chapel in Leeds—published a pamphlet that gave directions for dissolving fixed air in water. What we know as carbonated or soda water was seen by its inventor as an artificial replacement for the naturally aerated waters of certain mineral springs, which had long been regarded as good for the health. Apparatus for making the impregnated water was soon widely distributed; these machines, sometimes called gasogenes, appeared by the thousands in middle-class dining rooms before the end of the decade. Commercial manufacture of carbonated waters followed very soon thereafter, and supplies were taken on sea voyages to combat scurvy. Priestley regarded the health-giving properties of carbonated waters as God's gift to humanity, a providential reward for ingenuity and rational inquiry. Also in 1772, he published a celebrated paper in the *Philosophical Transactions* that described how air vitiated by combustion or respiration could have its "virtue" restored by allowing plants to grow in it or agitating it over water. Commenting on the process two years later in the first volume of his *Experiments and*

Observations on Different Kinds of Air, Priestley remarked that methods for restoring the goodness of air were part of the providential design, essential to the economy of nature as a whole.[66] He was confident that all putrid, respired, and noxious airs could be restored by these means. Thus, the role of plants in the order of nature was revealed, as was a hitherto unsuspected function of storms at sea. As Pringle put it, in a speech to the Royal Society in Priestley's honor, the agitation of the oceans served "to bury in the deep those putrid and pestilential effluvia which the vegetables upon the face of the Earth have been insufficient to consume." [67]

A further contribution of Priestley's 1772 paper was the "nitrous air test," which from this point assumed a critical importance in pneumatic chemistry as a way of assessing the goodness of air. In this procedure, a sample was mixed with what Priestley called "nitrous air," and the resulting product was observed to diminish in volume as part of it was absorbed by water. The degree of diminution was said to be in proportion to the purity of the sample, since it could be correlated with other measures of aerial purity, such as the ability to support combustion or respiration. For Priestley, the nitrous air test was a convenient gauge of aerial virtue; it was immediately seized upon by researchers looking for ways to measure the quality of the air in different places. Marsilio Landriani in Milan and Felice Fontana in Florence developed apparatus to perform the test and took them to urban and rural locations in northern Italy, making measurements of the healthiness of the air and its seasonal variations. Landriani's term *eudiometer* (from the Greek for "measure of good air") became the general name for this class of instrument. Designs varied from Priestley's own simple collection of tubes with a basin of water to the elaborate ivory and crystal presentation piece given by Landriani to Count Firmian, the counselor of state in Habsburg Lombardy.[68]

For a while in the late 1770s and early 1780s, it seemed that eudiometry would answer exactly the needs of aerial reform. Instruments were taken on field trips in England, Italy, France, and elsewhere, and they were even manufactured commercially. The York physician William White published a eudiometrical survey of the atmosphere of his city in the *Philosophical Transactions* in 1778. On a visit to London the following year, Fontana assessed the quality of the air in the streets and at the top of the dome of St. Paul's Cathedral. In 1780, the Dutch physician Jan Ingenhousz reported to Pringle on eudiometrical measurements made in the course of a voyage from London to the Netherlands. Usually, the results of these expeditions confirmed what was expected: the air was found to be purer out at sea than near to the coast, and decidedly impure in the vicinity of marshes or in

crowded city streets. But although the eudiometer could often be calibrated by reference to the sense of smell, long used to distinguish salubrious from insalubrious air, it turned out to be impossible to translate sensory impressions reliably into quantified measurements. The field descended into a series of fierce disputes among practitioners, each claiming a procedure that would yield replicable results while denouncing those of the others. Fontana attempted to introduce discipline into methods of measurement, and his system attracted some followers in England; but there was never a consensus that reproducible accuracy had been achieved. By the mid-1780s, it was generally doubted that nitrous air eudiometry would be able to provide the precise quantification of the healthiness of air that its early advocates had hoped for.[69]

The underlying assumptions of the eudiometrical program nonetheless persisted among those whom Priestley influenced. Kinds of air were to be arranged in a single scale of virtue, corresponding to their suitability for respiration and their general healthiness. Priestley understood this scale in terms of the theory of phlogiston, believed by chemists to be the principle of inflammability. Foul air was thought to be heavily contaminated with the phlogiston released by burning bodies and respiring people and animals. The less phlogiston in it, the better the air. In 1774, when Priestley produced a kind of air that could support respiration for even longer than normal atmospheric air, he named it "dephlogisticated air" and assumed that its high degree of respirability would make it especially healthy. Breathing the air, he reported a light and easy feeling in his chest; he speculated that "in time, this pure air may become a fashionable article in luxury."[70] The suggestion that this air (subsequently renamed "oxygen") could enhance health was soon investigated by physicians who were already using fixed air therapeutically. A group of doctors in the major provincial towns reported to Priestley about their experiments in treating patients with various gases. William Hey (in Leeds), Thomas Percival (in Manchester), Matthew Dobson (in Liverpool), John Haygarth (in Chester), and William Falconer (in Bath) were among the practitioners who adopted pneumatic therapy and became leading advocates for its effectiveness. Many of them had existing interests in the quality of the local atmosphere and its effect on the health of the population. Priestley's discoveries presented them with resources that were adaptable to local reform projects and to the therapeutic practices of enlightened doctors.[71]

While the findings of pneumatic chemistry gave medical practitioners new therapies for individual patients, reformers did not lose sight of the wider social agenda of the Hippocratic tradition. In fact, it was given a radical

new orientation in the last decades of the century. Priestley had encouraged many people to think about the role of scientific knowledge in general enlightenment and social reform. Aerial improvement could be seen as part of the overall progress of society, which for Priestley manifested the providential destiny of humankind. For him, technology or "art" did no more than exploit the God-given capabilities of nature; human progress could be expected to follow the path pointed out by divine guidance. Priestley believed that limitless progress in humans' intellectual, moral, and material condition would be the consequence of the spread of scientific knowledge. To those who shared his perspective, new knowledge of the medical benefits of gases appeared as a sign of the advance of society toward enlightenment. Obstructing this process—for the time being—were the agents of corruption: political tyranny, religious superstition, human folly. But Priestley was confident that these shadows would vanish as the light of knowledge dawned throughout society. Nothing could long resist the power of truth to make people healthy and free.[72]

Adam Walker, a Manchester schoolmaster who turned himself into a successful public lecturer in London and other cities, was one of the first publicists for Priestley's pneumatic researches after the author himself. He started to include them in his lectures in York in the early 1770s, and was later given apparatus by Priestley to use in his displays. Walker seems to have shared Priestley's views about the providential character of scientific discoveries and the role of education in public enlightenment. He lauded the rational knowledge of God that came from the study of nature, while castigating superstition and political tyranny. Writing in 1778 of the problem of bad air in large cities, Walker presented the issue in its moral context:

> It cannot too often or too forcibly be inculcated, how necessary to Health is the breathing of good air. When religious tyranny huddled its absurd votaries together near churches and monasteries; plagues, pestilences and famine announced the outrage unheard; 'twas the immediate finger of God, in the language of ungrateful and ignorant fatalists. . . . It may seem strange that in this age of philosophy and enlarged sentiment, we should run into similar error; but so it is; tho' we have opened our streets, pulled down our signs, and made sewers for every thing that may contaminate the air; a Court can seduce the active and needy with its employments, the rich and idle with its pleasures, and all with its Luxuries, Douceurs, and Fashions. Hence . . . our minds lose their relish for simplicity and nature; and

> even the Lungs accommodate themselves to a thick and putrid air, so as to be even offended by that of the Country. . . . It remains but for the philosopher to *moderate* the evil if possible, by his researches.[73]

Bemoaning the unhealthy consequences of luxury and fashion, Walker echoed a standard trope of the Hippocratic tradition. The artificiality of modern life had long been seen as exposing people to diseases, including those originating in the air. But Walker gave the lament a specifically political tinge by mentioning "religious tyranny" and linking it to the corruption of the "Court." He thereby associated the seductions of luxury and fashion with the superstitions of medieval Catholicism, an archetype of the obstacles that stood in the path of enlightenment. He also sounded a chord common in eighteenth-century oppositional rhetoric, which frequently denounced the royal court and the government ministers thought to be its lackeys. By the 1770s, this language was being taken up by the popular forces beginning to demand a greater degree of participation in the political process. Walker was aligning the campaign for aerial improvement with that against the corruption of an unrepresentative parliament and the established church, an orientation that reflected Priestley's own view of the radical political implications of his scientific discoveries.

In the 1790s, as partisan divisions deepened in British society in response to the French Revolution, and as Priestley was driven into exile in America following an attack on his Birmingham house by a reactionary mob, the program of pneumatic medicine assumed a strongly political coloration in the work of Thomas Beddoes, who took up the torch of Priestley's campaign. His medical training, his knowledge of pneumatic chemistry, and his political radicalism made him an appropriate inheritor of Priestley's legacy, though ultimately his reputation suffered even more severely from conservative scorn. In some respects, Beddoes's medical views descended from Cheyne's. He worried about the debilitating effects of nervous sensibility on people's health. Like many before him, Beddoes was convinced that the population was being softened and its resistance to illnesses weakened by the conditions of modern life, including fashionable clothing and people's indulgence in music and frivolous literature. He believed that increased nervous sensitivity led to such respiratory ailments as rheumatism, asthma, and consumption. One of Beddoes's therapeutic experiments took the pastoral, anti-urban theme of the Hippocratic tradition in a startling new direction. As a treatment for consumption, he recommended that patients sleep in cowsheds, in close proximity to the fumes

and excrement of the animals. Ladies of high fashion and developed sensibility could profit from this treatment, he assured his readers, provided they could steel themselves to the stench and the indignity.[74]

Beddoes began offering gaseous therapy to patients at his Pneumatic Institution, founded in Bristol in 1797. He presented it as part of a program to reform medical practice by making patients more responsible for their own health and reducing the authority of professional practitioners. His aims were consistent with ideals of comprehensive social enlightenment and were supported by sponsors who included many of Priestley's old friends, such as the doctors William Withering and Erasmus Darwin. They also, however, aroused opposition from the established medical profession and from a British government increasingly paranoid about political subversion. At one point, Beddoes was forced to admit, "I know well that my politics have been very injurious to the airs."[75] This opposition was fed by the dramatic discovery of the properties of nitrous oxide, introduced in 1799 by Beddoes's assistant, the young chemist Humphry Davy. Breathing this new gas produced effects of euphoria and giddiness—apparently like intoxication, but without the subsequent hangover. Davy and Beddoes made the gas available to a circle of their acquaintances, including the poets Robert Southey and Samuel Taylor Coleridge. The effects were widely reported and were used by conservative writers as a pretext to ridicule the whole program of pneumatic medicine. The Tory periodical *Anti-Jacobin Review* published two poetic satires targeting Beddoes's therapeutics along with the radical ideas of his friend Darwin. "The Pneumatic Revellers: An Eclogue," published in 1800, portrayed Beddoes and his colleagues as wild enthusiasts, using the gases discovered by the satanic Priestley to enjoy orgies of intoxication and sexual license. They were said to have been carried away by the force of their own imaginations, convinced that the new gases would usher in a utopian age of universal enlightenment in which mankind would "feed on *Oxygene*, and never die."[76]

Sadly, from Beddoes's point of view, the satire was far too close to the mark for comfort. He had indeed written of nitrous oxide and other gases as material agents of a possible universal enlightenment. He speculated with Davy about the chances that a "sublime chemistry" would make available to everyone the means to perpetuate pleasure and remove pain. But in a more pessimistic mood, he worried that "we might even prepare a happier æra for mankind, and yet earn from the mass of our contemporaries nothing better than the title of enthusiasts."[77] That was in fact just what happened. Beddoes and Darwin never recovered their reputations from the opprobrium and ridicule heaped upon them at this point. Both died within

a few years, their contributions to science and human welfare largely discredited. The younger men associated with them, like Davy and Coleridge, tacked to the right politically and tried to put their involvement in the nitrous oxide fiasco behind them. But the incident continued to be brought up occasionally by critics and satirists. In Thomas Love Peacock's novel *Nightmare Abbey* (1818), a character who seems to be based on Coleridge is identified by a young lady with the words, "You are a philosopher . . . and a lover of liberty. You are the author of a treatise called 'Philosophical Gas; or, a Project for the General Illumination of the Human Mind.' " [78]

The reduction of pneumatic medicine to a farcical scheme for the diffusion of "philosophical gas" was an attempt to denigrate the enlightened ideals that had found expression in the project. In the decades of political conflict that began in the 1790s, an intense struggle occurred to define the character of the Enlightenment as a whole. As a period of European history, the Enlightenment ended at the end of the eighteenth century; as an intellectual outlook with ambitions for freedom and progress, its longer-term survival was precisely what was at issue in the debates of the time. To this day, our understanding of the movement remains marked by the controversy that swirled around it as its historical moment came to a close. One aspect of this controversy was the fate of pneumatic medicine and atmospheric reform. Pneumatics as a form of individual therapy was disgraced, tainted by association with the despised philosophy of materialism, which Priestley had publicly articulated. This line of criticism revived the earlier strictures of Samuel Johnson against submitting the powers of the mind to the influences of the air. Pneumatic therapy was said to have attempted to use material influences on the body to fulfill the desires and aspirations of humanity; it had promised spiritual improvement through manipulation of the passions. This allowed its advocates to be portrayed as the latest incarnations of the seventeenth-century enthusiasts. Notwithstanding their declared faith in reason, they were accused of having surrendered their judgment to the intoxicating effects of artificial airs.

Johnson had prefigured this satirical characterization in an episode of his novel, *The History of Rasselas, Prince of Abyssinia* (1759). The hero of the tale, Imlac, tells of his encounter with an astronomer who believes that prolonged and deep study has given him the power to control the weather throughout the world: "The clouds, at my call, have poured their waters, and the Nile has overflowed at my command." Imlac concludes, however, that the astronomer is mad, deluded by an overactive imagination into believing that godlike powers are in his hands. He ascribes the man's madness to scholarly melancholy and isolation from the refreshing diversions of

society: "No man will be found in whose mind airy notions do not sometimes tyrannize, and force him to hope or fear beyond the limits of sober probability. All power of fancy over reason is a degree of insanity."[79] This was exactly the diagnosis of the pneumatic reformers by conservative critics forty years later. Surrendering to their own "airy notions," they were said to have allowed their ambitious imaginations to trump their powers of reason. They had thus brought ridicule upon themselves by trying to spread enlightenment by gaseous means.

Although individual pneumatic therapy was largely discredited at the end of the eighteenth century, ideas about the atmospheric origins of disease did not die out; nor did attempts to address them by environmental improvement. In this respect, the legacy of the Hippocratic tradition was part of the inheritance of the Enlightenment as a whole.[80] "Mending the air" continued to be a priority of activists in the emerging domain of public health. Bad air remained the distinguishing hazard of unhealthy places, associated with stagnant water, rotting waste, sewage, and corpses. Air was regarded as the primary vehicle by which putrefaction gave rise to diseases, and so irrigation was urged in order to carry away putrefying matter before it could infect the atmosphere. Thus, projects for drainage and sewage removal were prompted by foul odors and judged by the criterion of breathable air. As the great Victorian sanitary reformer Edwin Chadwick put it, "All smell is disease."[81] Furthermore, although the great sanitation projects of the nineteenth century unfolded in a very different social and political context, they remained rooted in conceptions of providence that descended from the Enlightenment, as Christopher Hamlin has pointed out. The Victorian reformers retained the notion of a single scale of aerial virtue; they assumed that the goal of human improvement was to restore the natural goodness of air as the key to health.[82] These assumptions underlay Chadwick's *Report on the Sanitary Condition of the Labouring Population* (1842), which in many respects carried forward the aspirations of enlightened atmospheric reformers. Notwithstanding the political crisis that had surrounded it at the end of the previous century, the ambition of changing the air in order to improve human health lived on, grounded still in an enlightened confidence in the providential goodness of nature.

This conviction had been shared by all sides in the eighteenth-century controversies. Cheyne, Short, and others castigated their contemporaries for their self-indulgence in luxury and fashion, for having sacrificed their natural robustness of health to modern comforts. They assumed that a return to temperance and self-control would restore the nation's health, because nature contained within itself the remedies for human disorders. If one ad-

justed one's life to live in a natural manner, one's health would be repaired by the natural goodness of the air. Priestley, Walker, and Beddoes, on the other hand, believed that the air in many places had been damaged by human misconduct. But again, the remedy lay within nature itself. Restoring the natural goodness of the air—by artificial means, if necessary—would allow people to recover their good health. Both individual therapeutics and large-scale projects for social reform were guided by this conviction. The common assumption of enlightened thinkers, whether conservative moralists or progressive reformers, was that the air was naturally good for human life and that providence had provided remedies for situations in which its natural virtue had been corrupted.

{ 6 }

Climate and Civilization

Nothing that depends on the social state, is so unalterably fixed, but that it will change and vary with the degradation or improvement of the human race. And hence, while the nature of man remains unaltered, the state of society is perpetually changing, and the men of one age and country, in many respects appear different from those of another. And as men themselves are more or less improved, every thing that constitutes a part of the social state, will bear a different appearance among different nations, and in the same nation in different circumstances, and in different periods of time.

SAMUEL WILLIAMS · *The Natural and Civil History of Vermont*

IN THE PREVIOUS CHAPTERS, we have considered how people's understanding of the weather in eighteenth-century Britain reflected changes in their society and culture. As they tried to make sense of their experiences of weather, they were made aware of the cultural transformation of their time—incomplete though it was when measured against the aspirations for comprehensive enlightenment. They came to recognize how hopes for the triumph of reason and social progress were constrained by the physical limits of human nature and the historical inheritance of attitudes and beliefs. Thus, we saw how "impolite" weather phenomena raised fears among the elite that unenlightened patterns of behavior would return, how "superstition" seemed to survive in connection with calendar lore and weather prediction, how even new instruments sometimes seemed to be treated like magical oracles, and how the influence of weather on health demonstrated

the vulnerability of human reason to bodily passions. In all these cases, experiences of the weather mirrored the circumstances of people at the time, as beings with physical bodies, situated in a specific historical context. How the weather was perceived was, in that sense, reflexive of the experience of enlightenment itself, which was always accompanied by an awareness of its incompleteness.

Relations between the physical environment and human culture were also extensively discussed by eighteenth-century intellectuals. In particular, they debated the relationship between climate and the progress of civilization. This manifested another dimension of Enlightenment reflexivity, namely, the consciousness of how nature and human life mutually shape one another. In eighteenth-century discussions, climate stood for nature itself; it signified the physical circumstances of existence in their bearing on human life. The key point is that nature was not regarded as an external force acting upon human beings from the outside. People were regarded as unavoidably *part* of nature, bound to it by the "human nature" that was thought to constitute their essence. There was a wide range of opinions as to the makeup of human nature—about the importance of its material component in relation to its spiritual or intellectual component, for example. But all eighteenth-century thinkers agreed that humans had an essential nature, grounded in their physical being and the circumstances of the world around them. They set out to derive knowledge of morals, society, and history by specifying this nature, assigning it a normative force in determining how people should live and an epistemological function as the key to understanding them. As Roger Smith has put it, "Nature itself thus set the conditions, Enlightenment writers argued, which made experience and history possible, and the language of nature set the terms in which man was to be understood." [1]

Furthermore, when writers of the time invoked nature, they did not think of it as set against culture or society. They did not operate with the conceptual dichotomies that would oppose these things to one another. Indeed, the concepts of "culture" and "society," as they are familiar in the modern human sciences, developed only in the nineteenth century.[2] Enlightenment thinkers assumed that what we call society and culture were manifestations—of one kind or another—of human nature. When they speculated about a "state of nature," they engaged in a fictional exercise designed to strip away the artificial elements and get back to what was natural, which was thought by many to provide a key to how people ought to live. Whether the state of nature currently existed in some part of the world, or had existed at a specific time in the past, was somewhat beside

the point. The reason it was invoked was to draw out essential features of human nature. The conclusions were much debated, but what was not contested was that, in all the varieties of civilized and uncivilized life, human nature was being expressed. This meant that material connections between human beings and their physical environment were always of interest. Intellectuals debated the magnitude of climatic influences, their relative importance in comparison with the other forces shaping human life, and how strongly they were expressed at different stages of the development of civilization. Throughout these debates, it was assumed that human beings were—to some degree or other—subject to the circumstances of their physical environment as a condition of their existence as creatures with material bodies.

The question of the bearing of climate on the development of human civilization was a particularly urgent one for Europeans who settled in other parts of the world. British colonists in North America, the West Indies, and India appreciated immediately that the climates in those places were very different from that prevailing at home. They set about investigating local conditions, using the techniques of systematic recording and instrumental measurement that had been used to chart the weather in Britain. They generated data for a series of comparisons, favorable and unfavorable, with the homeland. Physicians and surgeons serving with the British armed forces or practicing in the colonies carried the Hippocratic preoccupation with the effect of climate on human health into their new situation. They tried to assess the influence of heat and humidity, of soils and winds, of marshes and forests, on the settlers. While recognizing the different conditions, they also tended to perpetuate the concerns of British commentators with, for example, the dangers of luxury and fashion. They pondered the limits the local climate might set to the development of colonial society, and they also worried that inappropriate habits brought from home might make settlers especially vulnerable to airborne diseases.

The British colonies in North America presented a kind of laboratory for assessing how climate affected civilization. Early in the eighteenth century, American settlers began to adopt British methods of recording and measuring their weather. As they built up a picture of atmospheric conditions, they debated the influence of these conditions on prospects for social development. While the physical environment was seen in some respects as a threat to American society, the colonists also believed they were taming it by extending settlements, cutting down forests, and bringing the wilderness under cultivation. Nature, including the climate, could be "civilized" by these means. After the revolutionary break with Britain, Americans

developed their sense of themselves as an independent people. They often spoke of nature as an ally in the cause of independence and an asset that would support the growth of their civilization. Increasingly, they took pride in their climate, which they believed was being reshaped to serve the needs of the new nation. Like the British before them, the Americans came to value their weather as a national resource, one that contributed to their destiny. But whereas the British climate was thought suitable to an oceanic island with an important maritime role, the Americans saw theirs as fitting for a continental power destined to bring a vast territory under the sway of civilization.

The Enlightenment Debate on Climate

The eighteenth-century debate on climate and civilization unfolded within the framework of attempts to grasp human nature and understand its different manifestations in laws, manners, and customs. It was fed by the empirical inquiry into weather and its bearing on human health, which, as we have seen, had taken root in Britain in the early decades of the century. Although it drew upon ancient traditions of thought, the ensuing debate reflected distinctly eighteenth-century concerns with the history of civilization and its relations to nature. Thinkers approaching the issue often invoked certain dichotomies—for example, between the natural and the artificial, or between the mind and the body. But these dichotomies proved hard to sustain consistently and tended to become unstable. It was concluded, for instance, that even very artificial modes of life laid people open to the influence of the air on their health. Similarly, it was thought that the workings of even a highly refined mind could be subverted by atmospheric forces acting on the passions. Civilization, it seemed, did not permit people to escape the influences of their climate, any more than they could evade their human nature.

When the ancient writers talked of "climates," they referred to a notional division of the world into zones of latitude: frigid, temperate, and tropical. Each zone was supposed to be inhabited by people whose characteristics derived from the prevailing heat or cold of their atmosphere. Medical writers in the Hippocratic tradition had gone further than this, exploring human sensitivity to properties of the physical environment—including the air, waters, and soil—in specific places. As geographical knowledge expanded in the early-modern period, climate remained an important conceptual resource for coping with the diversity of human mores and institutions. Enlightened intellectuals used the idea to reconcile the variability of

humankind with the concept of an underlying human nature. But climate did not hold this privileged place in intellectual discourse for very long. By the early nineteenth century, attempts to stretch it to explain the whole range of human diversity came to seem artificial and unrealistic. As new disciplines developed, including biology and sociology, people came to understand the environment and its bearing on human life in new ways.[3] At the same time, many human differences came to be regarded as attributes of the different "races," supposedly rooted in the biological inheritance of the various strains of humanity. From this later standpoint, eighteenth-century ideas about climatic influences on cultural development seemed crude and confused. Historians who try to recover enlightened thinking on these questions confront a characteristically fluid situation, prior to the emergence of the disciplines that form the core of the modern social sciences. Eighteenth-century thinkers were pressing their intellectual inheritance to the limit. They were deploying the idea of climate to try to encompass the range of human social life at a time of considerable cultural change, when the very categories of thought they used to reflect on their societies were also being transformed.

The first eighteenth-century work to use climate as a key to comparative history was the *Réflexions critiques sur la poésie et sur la peinture* (*Critical Reflections on Poetry and Painting*), published in 1719 by Jean-Baptiste Du Bos and translated into English in 1748. Du Bos argued forcefully for the operation of physical causes in the rise of artistic creativity. He professed to see no other reason why certain settings—classical Athens, say, or Renaissance Italy—should have produced such extraordinary outbursts of cultural expression, while strenuous efforts by patrons and governments to reproduce them elsewhere had failed. Du Bos was vague on exactly what he meant by physical causes, and he offered little explanation of how they operated. He repeatedly used metaphors of natural growth, suggesting that the arts sprang up from the ground like well-nurtured crops. Although he could not say precisely what they were, he insisted that the qualities of the air were of crucial importance in determining the mental character of different nations: "The difference between the air of two countries is imperceptible to our senses, and out of the reach of any of our instruments; for we know it only by its effects."[4] Though he sometimes talked of the ancient climatic zones of the globe, implying that he saw temperature as the most important atmospheric variable, Du Bos's language mostly invoked a more general "nature" as the prime stimulus for intellectual vigor. The mind was said to be particularly susceptible to the influences of nature, conveyed through the qualities of the air.

Du Bos pointed the way to naturalistic accounts of cultural development that would encompass climatic influences, but he did not connect this with medical theories of the air's effects on the human body. That link was made by John Arbuthnot, in his *Essay concerning the Effects of Air on Human Bodies* (1733). Arbuthnot added to his Hippocratic discussion of the weather's influence on diseases speculations about how it also affected the characters of different nations. He mentioned a suggestion by Hippocrates, which was echoed by Du Bos, that Asians were disposed to accept despotism because of moral weakness caused by the hot climate. This became a common prejudice among European writers in the eighteenth century and was given renewed currency by Montesquieu. Those who lived in more bracing and variable climates were supposedly stimulated to more industrious and courageous activities. Arbuthnot thought that "Mathematicians, Philosophers, and Mechanicks" would tend to arise in a nation with this kind of climate, whereas "Painters, Statuaries, Architects, and Poets, which, besides the Rules of Art, demand Imagination" would come predominantly from warmer places.[5] As we have seen, the notion that climatic variability stimulated mental alertness was taken up by other British writers. Passions such as the imagination, on the other hand, tended to be seen as products of the balmier climes of the Mediterranean. Arbuthnot even suggested that variations in language might be ascribed to climatic differences. "The serrated close way of Speaking of Northern Nations, may be owing to their Reluctance to open their Mouth wide in cold Air," he suggested, "which must make their Language abound in Consonants; whereas from a contrary Cause, the Inhabitants of warmer Climates opening their Mouths, must form a softer Language, abounding in Vowels."[6]

The ideas of Du Bos, Arbuthnot, and others were taken up by Charles Louis de Secondat, Baron de Montesquieu, generally held to have been the most important writer on climate and civilization in the eighteenth century. While the originality of Montesquieu's thinking on this topic has probably been overestimated, his work was highly significant for integrating climatic influences into an account of social and political structures. He relied quite heavily on previous writers for his conception of how atmospheric properties affected human physiology, but he went much further, by situating climate in a comprehensive comparison of different societies that was widely read and debated. Although many subsequent thinkers disputed the role he had ascribed to climate, they were obliged to engage with Montesquieu's arguments. This kept ideas of climatic influences alive in all discussions of social development and its causes.

For Montesquieu, temperature was the atmospheric variable with the

most important physiological effects. His *Essay on Causes Affecting Minds and Characters* (written in 1736–43, but unpublished until the nineteenth century) discussed the effects of heat and cold on the nerve fibers, which in turn shaped the characters of different nations. Northerners were said to be sluggish but sound in their mental judgments, while southerners were quicker-witted but more subject to the passions.[7] At the same time, Montesquieu acknowledged other environmental influences, such as winds, qualities of the soil, and local foods. These were considered additional "physical" causes of specific mental characteristics. In his magnum opus, *Esprit des lois* (*Spirit of the Laws*; 1748), all of these causes found their place in the analysis of different structures of law and government. A few of Montesquieu's lines became notorious: his statement that "you must flay a Muscovite alive to make him feel"; his comparison of the audiences' reactions to operas in England and Italy; his experiment of freezing a sheep's tongue to observe the contraction of its nerve endings.[8] These images laid him open to criticism and even to satire, but they do not adequately represent his argument as a whole. Already in the *Essay*, he had listed "moral" causes that were counterparts to physical ones in forming the "general character" of a people. They included education, laws, religion, customs, and manners.

In the *Spirit of the Laws*, Montesquieu explored the relationship between the physical and moral factors lying behind national characteristics. He showed how social and political formations could be analyzed by isolating their essential features and tracing them to their underlying causes. Although systematic in its overall organization, the work proceeded by assembling aphorisms rather than by articulating a connected argument, so it was not easy for readers to extract a single point of view on this question. Many thought Montesquieu had given too much emphasis to climatic causes, but he also often stressed their subordination to moral ones. Where climate tended to weaken the moral strength of the population, he declared, legislators should act forcefully to counter its effects. Whereas "Nature and climate almost alone dominate savages," the societies of more civilized nations, such as the Chinese and Japanese, were governed by manners and laws.[9] By and large, climate made itself felt on the body, and Montesquieu supposed that—at least in more enlightened societies—the body would be subordinated to the rule of the mind. Thus, climate remained an important factor in the study of human society, but it was expected to be eclipsed in importance by manners and customs as civilization advanced.[10] As one might anticipate with an enlightened thinker, education in particular was ascribed great importance in enabling people to free themselves from the

constraints of their physical environment. Nonetheless, by placing climatic influences on a level to be compared with those of customs and law, Montesquieu had suggested that physical and moral causes were somehow equivalent. This kept the physical environment in play as a factor in the Enlightenment debate about social development, even though other writers disagreed sharply about how important it was.

A significant criticism of Montesquieu's theory was that it failed to articulate an account of social progress. Although he repeatedly stated that climatic influences could be subordinated by education and enlightened legislation, he did not spell out how societies developed toward a situation where these factors would prevail. His countryman Anne Robert Jacques Turgot initiated a line of thought among French intellectuals in which the scale of progress was used as a key for differentiating human societies, and in which climatic causes of variability were given much less emphasis.[11] In Britain, and particularly in Scotland, where questions of progress were also central to social theory, Montesquieu's ideas were subjected to fairly rigorous critique. The tone was set by David Hume, whose essay "Of National Characters" appeared in the same year as the *Spirit of the Laws*, and may have been framed as a response to it.[12] Hume systematically demolished the idea that climate alone could account for the variations between national characteristics, giving no less than nine instances of counterexamples: nations or peoples that enjoyed the same climate but were markedly different in characteristics, or places where the climate had remained constant but the attributes of the inhabitants had changed. He did not mention Montesquieu by name, and it is possible that his argument was aimed not at him but at the much cruder climatic determinism of Du Bos. Hume concluded that climate could not explain the differences among populations of the temperate zone, such as those of southern and northern Europe. He did, however, concede that there was reason to believe that peoples who lived "beyond the polar circles or between the tropics, are inferior to the rest of the species, and are incapable of the higher attainments of the human mind."[13]

Hume's concession was a revealing one, not just because it exposed a strain of prejudice that was lamentably common among European writers on human diversity, but also because it touched upon a difficulty with his argument. Skeptical as he was about the purported influence of climate, Hume nonetheless resorted to "nature" to account for what he considered undeniable differences in the cultural achievements of different peoples. In a footnote to his essay that has since become notorious, he asserted that black Africans were "naturally inferior to whites," since there "scarcely was a civilized nation of that complexion." He concluded, "Such a uniform

and constant difference could not happen, in so many countries and ages, if nature had not made an original distinction between these breeds of men." [14] So while Hume claimed that the influence of natural causes could be transcended by "civilized" nations, he was still willing to invoke them to explain the supposed backwardness of other peoples. Evidently, the physical environment could not be entirely discounted in the analysis of human development.

In principle, Hume's position was not all that dissimilar from Montesquieu's. Both expected morals, customs, and laws in enlightened nations to modify the influences of the physical environment; both resorted to nature to account for the state of uncivilized peoples. Furthermore, Hume's account of life in civilized societies left the door open to a degree of climatic influence that he was reluctant to admit explicitly. In his essay, he defined "moral," as opposed to physical, causes as "all circumstances which are fitted to work on the mind as motives or reasons, and which render a peculiar set of manners habitual to us." [15] The emphasis in his philosophy on habit, customs, and the passions, and the limited role he ascribed to reason in motivating human action, assigned prime importance to factors that had often been seen as susceptible to environmental influences. When he wrote in his essay that national characters were due to "a sympathy or contagion of manners," he named emotional attributes frequently viewed as subject to the forces of the atmosphere.[16] As we saw in the previous chapter, for many of Hume's contemporaries, "sympathy" was among the human characteristics most susceptible to the changing qualities of the air. Hume, it seems, had not squashed the argument for climatic influences on human life as conclusively as he claimed.

Hume's essay—both in its categorical assertions and in its ambiguities—set the tone for other Scottish writers in their response to the climatic theory in the 1760s and 1770s. On the one hand, Montesquieu was readily criticized by those who wanted to downplay the role of climate, often crudely reduced to the effects of heat and cold. On the other hand, physical nature could not be entirely excluded, especially when it came to discussions of the ways of life of "primitive" peoples or the role of sentiment and the passions in what were thought of as more advanced societies. The leading Scottish writers on comparative or "conjectural" history—John Millar, Adam Ferguson, and Henry Home (Lord Kames)—developed the four-stage theory of progress that saw all human societies as passing through a sequence of phases distinguished by their mode of subsistence. They acknowledged that climate was decisive for the earlier stages, when people lived in small bands of hunters and gatherers or as nomads, but they

routinely objected to Montesquieu's suggestion that it determined significant differences between nations at the more advanced stages, once settled agriculture and commerce had been established. At the same time, the possibility that climate could interfere with the process of social development itself could not be completely ruled out. Kames declared that a hot climate would prevent society from developing beyond the hunter-gatherer stage.[17] Millar wrote that differences among the English, Irish, and Scots, who shared essentially the same weather, showed that "national character depends very little upon the immediate operation of climate." But he also admitted that too little was known of what effects it might have.[18] Ferguson followed Hume in allowing that temperate Europe might have been climatically destined to lead the way in civilization. He wrote that European primacy manifested "either a distinguished advantage of situation, or a natural superiority of mind." [19]

Europe's apparent advantage in mounting the ladder of progress was one thing that made it difficult to discount the influence of the physical environment entirely. It was hard to see what else could explain how social progress had begun, even if one held that climatic influences had diminished as the process continued. Around the turn of the nineteenth century, theories of the human "races" began to be developed, which assigned different levels of intellectual capability to different populations. Then, European superiority was ascribed to the biological inheritance of the white race.[20] Kames pointed the way to this development by introducing the idea of "polygenesis," the notion that different strains of humanity had originated separately. But Kames also ascribed a role to climate in causing the "degeneration" of animal and human types in the New World, and he believed temperate conditions had aided European progress in civilization.[21] Most writers of the time did not regard racial markers as fixed or fundamental aspects of identity, and even skin color was thought to change under the influence of climatic conditions. Thus, climate was an obvious factor to turn to in order to account for European ascendancy. As the Scottish historian William Robertson put it, mankind "has uniformly attained the greatest perfection of which his nature is capable, in the temperate regions of the globe." [22]

Robertson's *History of America* (1777) reflected the Scottish writers' preoccupation with progress and their attempts to reconcile it with the role of climate. Only the first volume of the projected work was published, dealing with the European discovery of the American continent and the Spanish conquests. Robertson intended to resume the project with an account of the North American settlements after the war between the

colonists and the British crown was resolved, but he never did so. The part of the history that did appear featured environmental forces quite prominently. Robertson argued that they affected human vigor and sensitivity. In the New World, he asserted, "the principle of life seems to have been less active and vigorous . . . than in the ancient continent."[23] The weakness of the forces of nature touched the native people as well as the wildlife. According to Robertson, American natives were feeble in their bodily constitution and lacking in the facial hair that was a sign of manliness, sensibility, and sexual passion. He endorsed the conclusion of the French writer Cornelius de Pauw that "under the influence of an unkindly climate, which checks and enervates the principle of life, man never attained in America the perfection which belongs to his nature, but remained an animal of an inferior order, defective in the vigour of his bodily frame, and destitute of sensibility, as well as of force, in the operations of his mind."[24] Europeans, by contrast, had benefited from a temperate climate that induced both vigor and sensibility, qualities that found expression in their triumphant achievements in war, commerce, literature, and the arts. The benefits conferred by their climate had enabled the European nations to conquer the New World and subdue its native peoples. But according to Robertson, progress had also allowed them to modify their own climate and begin to change that of America itself.[25] As we shall see later in this chapter, he was not alone in believing that European settlers were taming the American climate by clearing forests and cultivating the land. Advanced societies were thought to be capable of taking charge of their climatic circumstances and civilizing the nature to which primitive peoples remained subject.

Robertson did not consistently analyze the relationship between climate and progress, but he mentioned the natural environment at a number of points in the course of his narrative, suggesting that it might hinder or encourage social development. He also declared that human progress always follows the same pattern, echoing the theory of his Scottish contemporaries. This seemed to make climate the accelerator or brake on the rate at which a society traveled the path of progress. Advanced nations were said to owe their emotional stability and refined social feelings to the influence of their temperate circumstances. But at the same time, they apparently had the ability to tame their climates and to direct the expression of sexual passion by moral legislation. Robertson was obviously conscious that climatic theory had its limits as a tool of historical explanation. He acknowledged that climate was "more powerful than . . . any other natural cause," and he understood the lure of trying to reduce human behavior to

laws of nature. But he concluded that "the operations of men are so complex, that we must not attribute the form which they assume, to the force of a single principle or cause." What he was sometimes inclined to call "the law of climate" could not be applied "without many exceptions."[26]

Robertson's work on America sketched one approach to the problem of integrating the natural environment into a history of the progress of civilization.[27] Addressing the issue more systematically, Robertson's compatriot James Dunbar, a lecturer in moral philosophy at King's College Aberdeen, argued that the impact of natural causes diminished as society improved. Dunbar admitted the influence of the physical environment on society as a whole—on its agricultural methods and on the health of the population. But he denied that this influence extended to the rational mind. Notwithstanding the "mysterious influence" said to operate on the mind from the body, he insisted that these forces could be overcome by the development of intellectual capacities by individuals and governments. Like Robertson, he believed that climate itself could be brought under human dominion, being increasingly subjected to rational improvement as the arts of civilization progressed.[28]

Dunbar seems to have been trying to dispel the worrying moral issues surrounding atmospheric susceptibility and the influence of the passions over individual behavior. In the face of such anxieties, he asserted the autonomy of the individual mind and civilization's power to subdue the forces of nature. Dunbar and his Aberdeen colleagues were uniformly hostile to materialism, which they associated with Hume's religious skepticism.[29] Hume, of course, had ostensibly rejected the influence of climatic forces, but the encouragement his philosophy was thought to give to materialism made it particularly important to try to demarcate between mental processes and the powers of the environment—difficult though it often was to do so. Not everyone was as sanguine as Dunbar that the progress of civilization would enhance the ability of human reason to keep the passions in check. As we have already seen, medical writers continued to insist on human vulnerability to atmospheric ailments, even in supposedly advanced countries. And as Dunbar was completing his *Essays on the History of Mankind* (1780), two Scottish-educated physicians were reasserting the argument that the qualities of the air had a substantial bearing on mental character and intellectual abilities. In 1780, Alexander Wilson produced his work *Some Observations Relative to the Influence of Climate on Vegetable and Animal Bodies*. Wilson had a medical degree from Edinburgh, where he had studied under the renowned clinical teacher William Cullen. His argument led off from what he took to be a consensus

view among scholars that inhabitants of the tropical and polar zones were incapable of achieving civilization. He mentioned Montesquieu's famous experiment with the sheep's tongue, but resisted what seemed to be one of its implications: that natives of the polar regions would be hardier than people from temperate ones. According to Wilson, people from frigid or torrid climes had the same physical and moral weaknesses. In these cases, climatic factors had to be invoked to explain their backwardness; it was only in temperate countries that moral causes could be expected to significantly improve the well-being of the people.[30]

A more ambitious articulation of the climatic argument was given by William Falconer, another former student of Cullen's. Falconer had moved into medical practice in Bath and developed an interest in issues of public health. He published *Remarks on the Influence of Climate . . . on the Disposition and Temper . . . of Mankind* in 1781, a book hailed by the twentieth-century scholar Clarence Glacken as "the most remarkable in its scope and tone" of all works on climate and civilization in the eighteenth century.[31] In this six-part work, Falconer tried to chart the influence of the whole range of climatic factors recognized by the Hippocratic tradition: weather, physical geography, diet, and customs. He also broadened the analysis to embrace the demographic knowledge that was emerging from contemporary studies of population. Finally, he attempted to integrate these factors with discussion of the progress of societies up the four-stage scale mapped by the Scottish philosophers. Falconer insisted that the action of environmental forces on the body was "by sympathy communicated to the mind"; the rational intellect could not be insulated from such forces. Emotions such as love, friendship, and social sentiment were highly subject to climatic influences, he claimed, a fact that explained the fortitude of northerners and the indulgence and effeminacy of southerners. In this respect, inhabitants of temperate regions were just as subject to their environment as those living at the poles or the tropics. Falconer allowed that the English tendency to high rates of suicide, remarked upon by Montesquieu and others, was "a disorder of the climate." People who lived in the temperate zone had refined but also inconstant manners. Their fickleness and independence of mind made them willing to experiment with social innovations, and hence allowed their societies to make progress. Unsurprisingly, it was in England that Falconer saw climatic forces converging in a positive direction. The English, more than any other people, he claimed, "possess a great thirst after knowledge, and desire of improvement."[32]

The works of Wilson and Falconer show that the climatic argument had not by any means suffered a fatal blow at Hume's hands. Hume had exposed

the cruder attempts to differentiate between nations on the grounds of temperature alone, exemplified by the work of Du Bos. But his argument could not entirely dispose of the possibility that climate had some bearing, at least at certain stages of social development. His successors among Scottish philosophers conceded environmental influences on the body, but tried to hold the line against admitting their action on the mind. Historians struggled to integrate climatic forces into their accounts of social progress, formulated under the influence of the four-stage model. And as we have seen, medical writers—apparently ignoring the reservations of the moral philosophers who feared that such an approach pointed the way to materialism—reasserted the importance of climate three decades after Montesquieu first brought it to widespread attention.

The situation in the 1780s foreshadowed, in some respects, the subsequent fate of climatic accounts of the development of civilization. In the following decades, biological theories of racial differences took over some of the work of explaining why some cultures had risen to advanced stages of civilization while others had not. The category of "race" was broadly conceived to include mental as well as physical characteristics of human beings. Understood in these terms, race came to be regarded as an essential component of inherited identity. The new theories drew upon much accumulated prejudice, especially concerning Africans and Native Americans, as the derogatory remarks of Hume and others testify. In this respect, there was a degree of continuity with Europeans' habitual condescension to other peoples. But race as a theoretical formation was premised on the basic immutability of personal identity, and hence challenged climatic accounts of diversity with their assumptions of the plasticity of human character.

Nonetheless, environmental explanations of human attributes did not entirely die out at the end of the eighteenth century. Instead, they took somewhat different directions in the social and the natural sciences, a dichotomy prefigured by the division between Dunbar and the medical writers Wilson and Falconer. Dunbar resisted the idea that the air could directly affect the individual mind, but he acknowledged an influence of climate on society as a whole. Environmental forces became something like a "social fact," apparent at the level of the collectivity but not at the level of the single individual.[33] This indicated how social analysis was to separate from medico-biological thinking, which, in the work of the medical writers who were contemporary with Dunbar, continued to posit the human body's dependence on its material surroundings. In the nineteenth century, environment or "milieu" became an important theme in sociology, though detached from ideas of weather or climate. It was invoked in connection

with a specifically social ontology to explain aspects of collective behavior and attitudes. Biology, on the other hand, assumed the duty of explaining how physical nature affected individual organisms' development. This was a feature of evolutionary theories of organic development, which began to emerge in the 1820s after surviving for decades in the shadowy underground to which fears of materialism had confined them. Nineteenth-century sociology and biology, then, built in different ways on the legacy of eighteenth-century climatic theories. From a retrospective point of view, intellectuals of the earlier period seem to have held several pairs of themes in tense alignment: the individual and the collective, the path of progress and its deviations, plasticity and immutability of character, the laws of nature and historical narrative. These productive—though ultimately unstable—categories of thought provided the framework in which the project of understanding the development of civilization unfolded, and in which the concept of climate proved so irresistible to enlightened thinkers.

Medicine and the Colonial Situation

The interventions by Wilson and Falconer in the debate on climate and civilization in the 1780s are a reminder that medical men—as well as philosophers and historians—were concerned about the influence of the weather on human life. In the previous chapter, we looked at how this concern was expressed in Britain, where the climate was blamed for many medical problems, notwithstanding its generally favorable reputation as an asset to the nation. Even the homely British weather was thought to pose certain risks to health, especially to those whose constitutions were inherently weak or who had made themselves vulnerable by intemperance. The turn of the seasons brought a regular cycle of complaints—colds, coughs, catarrhs, rheumatism, and various fevers—and more rapid changes in the weather could also cause outbreaks of illness. When British people explored and settled in other parts of the world, they faced even more serious threats. Movement to an unfamiliar climate was generally held to open individuals to the risk of a whole range of virulent, and frequently fatal, ailments. The diseases known today as malaria, cholera, typhoid, and others were usually classed as kinds of "fever" by the eighteenth-century doctors who struggled to understand and treat them. Medical practitioners were convinced that the afflictions had their origins in the environment in which Europeans settled. In line with the Hippocratic perspectives already deployed at home, they focused on the physical situation in which the colonists lived, includ-

ing the qualities of the air. What came to be called "tropical medicine" began with British doctors applying their homegrown ways of thinking to the alien climates in which their countrymen had settled.[34]

In most of these locations, including India, the West Indies, and North America, heat and humidity were reckoned the most dangerous atmospheric qualities. Their hazards could be accentuated by such geographical features as marshes and forests, and by unwise choices of clothing and habits. Hans Sloane, who accompanied the Duke of Albemarle to his posting in Jamaica in the late 1680s, discussed these issues in the published account of his voyage. Sloane wrote at length of the topography, botany, and human geography of the island. He detailed its climate with its heat, rainfall, and refreshing breezes. And he gave extensive descriptions of the illnesses he had treated among the colonists. He identified temperance as crucial to determining a patient's chances of survival. A truly temperate individual might live to be a centenarian in such a climate, he claimed. But one who indulged in excessive eating or drinking, or in the debaucheries of "venery," would surely succumb quickly to the prevailing diseases. Temperance was important not only because—as physicians since antiquity had asserted—it strengthened the constitution, but also because it aided settlers' adaptation to local conditions. The less stress placed on the constitution, the more readily it could adjust to the climate. Sloane advised British colonists in Jamaica to abandon European fashions in clothing and to mimic the manners of native people and African slaves.[35]

All of these themes were echoed in the works of subsequent medical writers. They recognized that tropical climates posed specific health hazards for settlers, due to their stark deviation from the conditions of the British homeland. Heat and humidity were the most obvious differences, noticed by everyone, and they formed the starting point of attempts to trace the physiological causes of tropical diseases. Charles Bisset, who served as a military surgeon in the West Indies and North America in the early 1740s, wrote about the health risks for settlers on the Caribbean islands. Heat tended to rarefy the blood, he claimed, but it also promoted perspiration, which was healthy. The real danger came when the air was humid as well as hot. Then the fibers of the body could become dangerously "relaxed," leading to fevers and diarrhea. Newly arrived settlers were particularly vulnerable to these ailments during the sultry days of late summer and the subsequent rainy season.[36] William Hillary, who practiced on Barbados a decade later, followed Hippocrates' recommended procedure of studying the topography of the island as a key to its ailments. He measured the qualities of its atmosphere with a Fahrenheit thermometer, supplied

from Amsterdam, and a portable barometer he had brought from London. He accounted for the physiological effects of heat and humidity in language similar to Bisset's. Heat was seen as expanding the fluids and relaxing the fibers of the body, thus expelling noxious materials from the skin. This could be observed in the small red lumps on the limbs, which people mistakenly believed were caused by the bites of mosquitoes. They were actually, Hillary claimed, signs of a healthy process of perspiration. Problems arose only if sweating was hindered by high humidity or inappropriate clothing. Hillary recommended that settlers abandon European styles of clothing, such as thick coats and waistcoats, and instead adopt the "banjan," a loose gown like those worn in Asia.[37] The banjan, or banyan, did in fact become quite fashionable in North America and Europe; its use could be rationalized on the medical grounds that it permitted free and healthy perspiration.[38]

The British colonies on the American mainland were closely connected with those of the Caribbean. Ships frequently traded between them, as well as linking them with the homeland on the other side of the Atlantic. It is not surprising that doctors in the North American colonies shared the general outlook of those practicing in the West Indies. Among them were two Scottish physicians working in partnership in Charleston, South Carolina: John Lining and Lionel Chalmers. Lining, originally from Lanarkshire, settled in Charleston in 1730.[39] He approached the question of the physiological effects of the climate by personal experimentation in the tradition of the seventeenth-century Paduan physician Santorio Santorio. Lining compiled meticulous records of his own intake of food and drink and his output in perspiration, urine, and feces from March 1740 through February of the following year. He weighed everything he consumed and all his evacuations; he weighed himself twice every day (on rising and before going to bed); and he also recorded his pulse rate. He combined this with a detailed record of the weather, using instruments to measure the barometric pressure, temperature, rainfall, and atmospheric humidity. Lining's journal was published in the *Philosophical Transactions* of the Royal Society. The author expressed the hope that his record would illuminate "the Changes produced in our Constitutions, disposing us to such and such Diseases, in certain Periods of the Year."[40]

While Lining approached the topic through narrowly focused—not to say obsessive—experimentation, his colleague Chalmers developed its wider social dimension. In his *Account of the Weather and Diseases of South Carolina* (1776), Chalmers explained that people were essentially the same everywhere, and "not otherwise to be distinguished from each other, than

so far as they may be of more firm or feeble habits, according to their various climates."[41] This made the issue of climate fundamental to the health, welfare, and prosperity of the American population. Chalmers cast an anxious eye over the apparently unhealthy aspects of the Charleston milieu: the marshes with their mephitic stagnant water, the unwholesome fogs and dews, and the seasonal hazards of heat waves, tornadoes, and hurricanes. He shared the common belief among the colonists that the air would be improved by clearing forests and bringing more land under cultivation. So long as forests continued to surround his town, he wrote, the stagnant air "in those close recesses . . . renders them more proper for the habitations of wild beasts than of men." But not all social development was welcome: increased luxury and dissipation would weaken people's resistance to disease. Chalmers was particularly concerned about tea and coffee drinking, which, he fretted, "cannot fail in having ill consequences, in some constitutions, particularly during the relaxing heat of summer."[42] British writers such as George Cheyne had already developed the theme of the bad consequences of luxury and fashion for personal health. Tea and coffee were frequent targets for censure; these beverages—along with wearing fashionable clothing, dancing, and congregating in crowded rooms—were thought to increase people's susceptibility to airborne diseases. Chalmers was echoing this moralizing tendency in the British discourse of public health and reorienting it to the climatic situation of the colonies, where the dangers of lax behavior were heightened by an unfriendly environment.

The castigation of extravagance and immoderation, especially in female behavior, became a standard topic of medical writings about the hazards of colonial climates. As has been mentioned, Hillary criticized women for disregarding his advice not to exercise too vigorously. Their fondness for dancing was putting their health at risk, he warned—a point echoed by James Johnson in India in the early nineteenth century.[43] Even after the American colonies gained their independence, male observers (both American and foreign) continued to criticize women for indulging in habits that increased their vulnerability to the diseases of the climate. William Currie, a Philadelphia physician writing in the early 1790s, declared that women's illnesses were due to their drinking too much tea, breathing the air of confined spaces, frequently changing their dress, "and the alternate vicissitudes from heat to cold, to which fashion, and the love of pleasure, expose them." Currie broadened his reprimand to include young women who read "Love-inspiring Novels," who "not only impair their constitutions, but pervert their imaginations, and corrupt their morals to such a degree, that they are ever after rendered unfit for the offices of domestic life."[44] In

the following decade, the French visitor Constantin François de Volney cast a sardonic European eye over the unhealthy indulgences of the Americans. All of them, he said in 1804, "live in a state of perpetual indigestion extremely favourable to catching colds." But he criticized women especially, whose susceptibility was said to be increased by light, fashionable clothing, "overheated apartments, balls, tea-parties, and featherbeds." [45]

These condemnations by male observers of women's behavior suggest that a general moral anxiety was sharpened by what were thought to be the climatic hazards of the colonial situation. In Britain, men resented women who were acting independently and enjoying new recreations, and doctors took it upon themselves to tell women that they did so at risk to their health. These dangers were thought to be increased in a setting in which the passions were likely to be less restrained than in the temperate homeland. Writers on climate and character generally agreed that hot weather lessened the inhibitions on sensuality and the other passions. In this respect, "relaxation" was both a physiological and a moral problem. The same circumstances that would loosen the bodily fibers and expand the fluids would also reduce conscious restraints on feelings and behavior. It was therefore thought particularly important to uphold rigid moral standards. A number of writers on tropical medicine emphasized this imperative.[46]

There was also, however, an underlying assumption that some sort of adaptation to local conditions was necessary. Medical writers did not advocate abandoning moral constraints, but they did often endorse the adoption of at least certain local habits. Thus, Sloane and Hillary advised settlers to relinquish their habitual clothing and assume a garb more suited to the climate. They urged the colonists not to exercise as vigorously as they were accustomed to at home. The rationale was to allow the individual to become acclimatized. It was assumed that a settler from Europe would gradually adjust to a tropical climate, if nature was allowed to do its work. Just as plants and animals were thought to be transplantable to distant places, so people were expected to be modified by the forces of nature itself to fit the climate to which they relocated. This was sometimes called "seasoning." [47] The great naturalists of the Enlightenment, including Carolus Linnaeus and Georges Louis Leclerc, Comte de Buffon, experimented with relocating plants and animals from the tropics to European institutions. They believed that climate would be the means by which natural forces would fit the organisms to their new circumstances.[48] Human beings were thought capable of a similar adjustment, even to the extent of changing their skin color, provided they allowed nature to act on their bodies. Everyone knew that Europeans became darker after they lived for a while in the tropics,

and darker-skinned people were said to have become paler when relocated to Europe. It was widely reported that Portuguese settlers in West Africa had darkened over several generations, to the extent that they were now indistinguishable from natives. Writers on the phenomenon presumed that climate was the agent of these changes.[49]

The "seasoning" perspective generally held sway in tropical medicine, until it began to be challenged by notions of racial immutability just before the turn of the nineteenth century. Medical writers agreed that new arrivals in the tropics were the most vulnerable to the local diseases. If they survived a year or so, their chances thereafter would be much improved by having adapted to the conditions. James Lind, who as a naval surgeon pioneered methods for preventing scurvy on British ships, wrote his *Essay on Diseases Incidental to Europeans in Hot Climates* (1768) as a manual for settlers and soldiers in the tropics. He stressed that the climate outside Europe had frequently proved fatal to colonists, and that even adoption of a temperate mode of life provided no guarantee of survival. Every country, however, had its healthy places and its relatively healthy seasons. The best advice was for settlers to evacuate during the hazardous months to locations with more healthy air, at least in the first year or until they had become acclimatized.[50] An army physician, John Hunter, drew upon the work of doctors in Africa and India to address the specific situation of soldiers in the West Indies in his *Observations on the Diseases of the Army in Jamaica* (1788). He painted a shocking picture of army losses to disease during recent military campaigns, estimating that up to one-third of the members of active units were unavailable for duty at certain times because of sickness. In the course of a year, approximately one-quarter of the troops in service in Jamaica died of disease. These losses could barely be replenished by new recruits from Britain, especially because the new arrivals were particularly likely to succumb. Advice to soldiers to avoid intemperance could do little to meliorate this dire situation. The only remedy was to allow newly arrived troops to acclimatize gradually in the most healthy places that could be found. Duly seasoned, they would have at least a fighting chance of resisting the onslaught of the diseases that felled so many of their comrades.[51]

The expectation that Europeans would adapt to tropical climates did not mean they were supposed to be entirely passive in their occupation of new settlements. Although seasoning was supposed to occur by allowing the forces of nature to work upon the bodies of settlers, there was also scope for active intervention to alter the environment. Improvement of the air was seen as a way to help nature exert its beneficial effects, as Sir John Pringle influentially urged. His *Observations on the Diseases of the*

Army (1752) recommended that military camps be sited away from marshy ground, to avoid the "putrid miasma" it emitted. As we have already seen, Pringle energetically advocated a whole range of environmental interventions in Britain to improve the atmosphere surrounding human habitations. Similar improvements were also advocated in overseas possessions, where draining of swamps and clearing of forests were urgently demanded to improve the healthiness of the atmosphere. Lind noted that stagnant water and marshes, even in England, produced vapors that were noxious to health; they were necessarily much more hazardous in the tropics. Equatorial Africa was notorious for its hot and swampy air, but Lind was confident that "if any tract of land in Guinea was as well improved as the island of Barbadoes, and as perfectly freed from trees, shrubs, marshes, &c. the air would be rendered equally healthful there, as in that pleasant West Indian island." [52] The Portuguese had already shown, he claimed, that a settlement on the Congo River could be as healthy as anywhere, once its surrounding trees were cleared.

Settlers and observers in many British overseas possessions shared the belief that clearing forests and marshes would improve the quality of the local air. In the homeland, the fact that the climate was seen as a gift of providence did not mean that it could not be improved; in many colonial settlements, it was thought imperative that it should be. Chalmers looked forward to the time when improvements in the vicinity of Charleston would allow refreshing breezes from the ocean to circulate more easily. Hunter wrote that "noxious exhalations from wet, low, and marshy grounds" had been shown unhealthy "by repeated experience and observation in all parts of the world." [53] In view of this, army camps should preferably be located on hilltops or coasts, and it should be a military priority to clear and drain the land near existing sites. Of course, the heavy work would usually not be done by British settlers or soldiers themselves. Both Hunter and Lind made it clear that African slaves would be used to clear land in Africa and the West Indies.[54] So while Europeans prided themselves on their capacity to improve on nature, which they believed placed them at the apex of human civilization, they often made use of the labor of slaves to get the job done.

By the early nineteenth century, doubts began to be voiced about the idea that settlers would become seasoned to the climate in which they lived.[55] James Johnson, in his *Influence of Tropical Climates* (1813), insisted that the superiority of human beings over animals lay in the ingenuity of their minds, not the pliability of their bodies. He denied that humans shared animals' natural ability to adapt to their environment. Skin col-

or would not in fact change, even over several generations. To say that it would seemed, to Johnson, to give comfort to the "gloomy doctrine" of materialism. He insisted that it was particularly unwise for Europeans to try to acclimatize by mimicking native customs, which "in reality, have ignorance, superstition, or even vice for their foundation."[56] They must trust to their intellectual capacity to fit them for life in the tropics, not hope that their bodies would adjust naturally. The colonists' strongest ally was their moral and mental superiority over the natives, not a natural ability to become seasoned to the prevailing conditions. Johnson told his readers that the inherent racial superiority of Europeans was the key to their ability to settle anywhere in the world. His outlook was consistent with the growing conviction among British intellectuals at the time that racial characteristics embraced mental as well as physical qualities, and that they were an immutable inheritance of the different strains of humanity.

Even while the notion of inherent racial differences took hold, however, European settlers did not completely abandon the hope that they could eventually adapt to life in tropical conditions. In the early nineteenth century, settlers in the American West held to the faith that they would become acclimatized, even sometimes worrying that the process would compromise their racial identity as white people.[57] In the eighteenth century, the prevailing assumption was that, given time, nature would fit people for the climate in which they lived. Underlying this belief was a sense that human nature linked people to their physical environment through bodily experience. As creatures of flesh and blood, human beings were inevitably affected by temperature and other atmospheric qualities, which penetrated their bodies and altered the rigidity of fibers and the velocity of fluids. These changes were thought to lie behind the alterations in people's health and passions that had repeatedly been catalogued in studies of weather and climate in many parts of the world. Whatever state of social development they enjoyed, human beings would inevitably remain subject to nature. This being so, climate would be the means by which nature would exert its unavoidable influence over European settlers in the tropics. This did not mean that the colonists should be entirely passive in their new environment. There was no escaping the effects of nature, but nature could be molded to exert its effects in a more desirable way. Hence the programs for improving the quality of the environment in the colonies by reshaping the landscape around settlements. Taking control of their physical surroundings by draining swamps and clearing forests allowed European settlers to enroll nature as an ally in their campaign to civilize the world around them and ease the process of acclimatization.

America: Climate and Destiny

The debate about climate and civilization engaged philosophers, historians, medical writers, and settlers themselves. It was conducted across a wide geographical range, frequently making comparisons between the British homeland and its far-flung colonial outposts. Climate was invoked as a way of trying to account for the diversity of humanity and for the many stages people seemed to occupy on the ladder of social development. It was thought to affect the physical dimension of human nature, requiring the adjustment of manners and laws to address its undesirable consequences. The British colonies in North America faced the conditions of their own climate with an outlook shaped by this debate. From the time when they first encountered it, the American continent had presented a challenge to Europeans' climatic expectations. In the eighteenth century, it also provided a focus for the debate on human history and the environment. Before and after the United States gained its independence, writers in Europe and America discussed how physical circumstances would shape the destiny of this society. Enlightened thinking about the relations between climatic conditions and the progress of civilization was of obvious importance for those seeking answers to the question. European writers were often read as denigrating American nature by suggesting that its climate had stunted the growth of animals and native human beings and by implying that it would limit the degree to which civilized society could develop there. American writers spoke up for their natural environment—and to some extent for their native peoples—against these strictures. They acknowledged differences between European and American climates, while minimizing the disadvantages and maximizing the advantages of the latter. Particularly after independence, Americans defended their natural environment as a support for the building of the nation.

In this connection, Europeans and Americans gave particular prominence to the idea that the climate was being changed by the consequences of colonial settlement. The clearing of forests and the cultivation of land by agriculture were almost universally said to have had measurable effects on the climate since Europeans first landed on the continent. These effects were also said to be noticeable in other colonial outposts, such as tropical islands; but they were emphasized with unparalleled regularity by commentators on America. There were two main reasons for this. First, writers on both sides of the Atlantic wanted to believe that nature was being civilized in the New World. America was a great project, in which many Enlightenment hopes were invested, and it was expected that the taming of its

wilderness and climate would follow from the expansion of its settlements. A second reason for the expression of these hopes in relation to America was the fate of its native peoples, who had suffered a disastrous decline in population since the arrival of Europeans, primarily due to epidemics of such fatal diseases as smallpox. The continuing decline of the natives gave particular urgency to consideration of the role of climate by the settler population. It was hard to resist the assertions of writers in Europe who claimed that the American climate had had a damaging or weakening effect on the natives. Though American writers often denied that this was so, and did what they could to defend the natives' reputation for vigor and strength, they also sought reassurance in the belief that the climate was changing. It was important to assert that whatever its undesirable consequences in the past, its effects were no longer to be feared. These two factors inclined American writers to see the climate as having been significantly transformed since European settlement began. The climate Americans claimed as a national asset was one they believed they had molded—and were continuing to mold—to meet the requirements of their civilization.

The weather in the New World had posed a conundrum to settlers from the beginning. Europeans venturing across the Atlantic quickly noticed that American locations were much colder in winter than the corresponding latitudes in Europe; in summer they could be hotter and considerably more humid. To determine the prospects for settlement, it was essential to find out what local conditions were like and how they varied with the seasons.[58] By the late seventeenth century, British methods of systematic weather recording were being used to chart conditions in America. The Royal Society welcomed reports from the other side of the Atlantic that used these methods. In the 1690s, letters by John Clayton about the natural history and climate of Virginia were published in the *Philosophical Transactions*. In a Hippocratic vein, Clayton, who had been a minister at Jamestown in the 1680s, noted how sudden changes in the Virginian weather affected the health of the inhabitants. Thomas Robie kept a weather journal (though without instruments) from 1715 to 1722 at Harvard College in Massachusetts, where he served as tutor, sending it later to William Derham to share with the London virtuosi. James Jurin's invitation to meteorological record keepers in the early 1720s met with a response from Isaac Greenwood, a professor at Harvard, whose proposals for compiling a "natural history of meteors" appeared in the *Philosophical Transactions*. A few years later, Paul Dudley, a judge of the Massachusetts Superior Court, sent another weather journal to the Royal Society covering the years 1729 to 1733.[59]

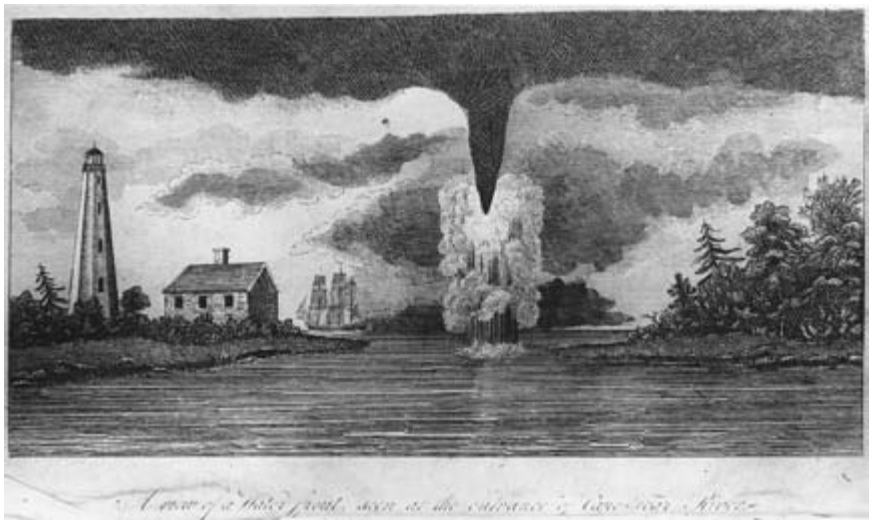

FIGURE 18 · "A View of the Waterspout Seen at the Entrance of Cape Fear River." An American weather wonder shown in the frontispiece to Thomas Branagan, *The Pleasures of Contemplation* (Philadelphia, 1817). Courtesy American Antiquarian Society, Worcester, Massachusetts.

These colonial observers looked to London for accreditation and publication of their research. They participated in a transatlantic trade, in which specimens and written descriptions were centralized in the metropolis and paid for in the currency of social prestige minted by such institutions as the Royal Society. Naturalists and weather observers in the American colonies attached themselves to the far-flung networks by which this knowledge was accumulated in the imperial capital. They also imported meteorological instruments from the metropolis. After a series of mishaps attending their transportation across the Atlantic, barometers and thermometers began to be made available in the colonies by the 1720s. They were soon used to report atmospheric measurements to London. Harvard received a portable barometer for its instrument collection in 1727, and it was used by Greenwood for observations. John Winthrop, Greenwood's successor in the Hollis chair of natural philosophy at Harvard, compiled a record of temperature and pressure in Massachusetts from 1743 to 1747, which he sent to the Royal Society.[60] At around the same time, Lining was using instruments in South Carolina. The following decade saw measuring apparatus being used systematically by Chalmers at Charleston and by Hillary on Barbados. By the beginning of the nineteenth century, Volney noted acutely that Brit-

ish and American meteorologists shared the same quantitative approach to their subject when, "conformably to the national genius, [they] reduce every thing to direct and systematic calculations."[61]

American weather observers shared methods with their British colleagues and echoed many of their preoccupations. Their comments often took it for granted that the British climate was the norm and that American conditions were hazardous insofar as they deviated from it. Thus, extreme temperatures were of great interest, particularly when they could be quantified. The *Philosophical Transactions* published accounts of winters at Hudson's Bay when it was so cold as to freeze the mercury in the thermometer tube, and of summers in Georgia when 102 degrees was recorded on the Fahrenheit scale. In the summer of 1752, Chalmers measured the heat in his kitchen in South Carolina at 115 degrees. He anticipated that his record of the occasion might "not displease the curious," as no register of such a hot season had previously been published.[62] Such extreme departures from the temperatures usual in Britain gave rise to serious worries about their effects on health. Chalmers noted that the hot and humid summers in Charleston were particularly dangerous times for fevers.[63] Similarly, Lind commented that the hot locations in North America were the ones where settlers' health was particularly precarious. Like other medical writers, these two often made comparisons between the American colonies and British settlements in the tropics. But there were also writers, such as William Robertson, who emphasized the prevalence of cold in America and who traced its negative effects on the health and vigor of the inhabitants. Whether perceived as too hot or too cold, it was the American climate's differences from the British climate that aroused anxieties about sickness.

A further aspect of the exoticism of the American climate was its apparent fertility in atmospheric wonders. Reports of tornadoes, waterspouts, hurricanes, thunderstorms, and other prodigious meteors appeared frequently in metropolitan and colonial publications. In colonies where Puritanism was influential, such phenomena continued to be regarded as divine portents well into the eighteenth century. The arguments about their reducibility to natural law—arguments that, we have seen, swirled around the storm of 1703 in Britain—resurfaced periodically.[64] In Boston, John Winthrop championed the naturalistic view, initially in connection with an earthquake that struck New England in 1755, then on the occasion of a comet in 1758, and later in descriptions of a series of fiery American meteors sent to the Royal Society in the 1760s.[65] The problem was that the more the descriptions of such anomalies were elaborated, the more difficult it was to assimilate them to the regular order of nature. Benjamin

FIGURE 19 · Benjamin Franklin and lightning. The American philosopher with accoutrements of his electrical experiments, from a mezzotint portrait of the 1740s. Courtesy of Science and Society Picture Library, London.

Franklin's work on lightning, beginning in the 1740s, aimed to reduce the phenomenon to natural law and lessen its dangers with the use of lightning rods; but it also made everyone aware of the violent electricity of the American atmosphere. As the fame of Franklin's accomplishments spread, it came to be generally accepted that the air was more electrically charged in America than in Europe.[66] These wonders added to anxieties about the hazards of the American climate and to the urgency of the task of taming it.

In the context of such worries, the idea of a transformation of the American climate assumed considerable prominence. It was widely asserted that settlement and cultivation of the American landscape by Europeans was bringing the weather into line with the temperate ideal of the Old World. The cutting of American forests, especially, was said to be moderating seasonal extremes of temperature.[67] Comparisons were made with

the changes said to have occurred in the European climate since ancient or medieval times. Centuries of civilization in Europe were thought to have ameliorated the brutal weather conditions recorded by classical writers. European settlers in North America believed they were effecting a similar transformation in a much shorter period. They thus ignored the role of the native peoples in shaping the landscape of the Americas, dismissing their agriculture as insignificant and minimizing the scale of their settlements. It was said that the wilderness had remained unimproved until the arrival of Europeans, who had begun the process of civilizing the American environment and softening its climatic extremes.

In the second half of the eighteenth century, this idea came to be widely credited by European and American writers. Pehr Kalm, a Swedish follower of Linnaeus, raised the matter in his account of a visit to the New World in 1749. He was told by old people he encountered in New Jersey and Quebec that the winters had previously been longer and harsher, and the yield of the wheat crop much less. He was also told that people ascribed the climatic amelioration to the clearing of trees, which allowed the sun to act more directly on the soil.[68] In a paper read to the American Philosophical Society in Philadelphia in 1770, Hugh Williamson, a Philadelphia physician, claimed that eastern North America had become significantly more temperate after settlement, especially because of deforestation. He stated that removing forests would lessen the cold of winters and the heat of summers, with consequent benefits for people's health.[69] The assertion was picked up by European writers such as Buffon, who included the draining of marshes among the causes of the alteration. In his *History of America*, Robertson contrasted the industrious cultivation of the American landscape by European settlers with its supposed neglect by the native peoples and pointed out that "when any region lies neglected and destitute of cultivation, . . . the malignity of the distempers natural to the climate increases."[70] Robertson's fellow Scot James Dunbar agreed that "by opening the soil, by clearing the forests, by cutting out passages for the stagnant waters, the new hemisphere becomes auspicious, like the old, for the growth and population of mankind."[71]

In America itself, the belief that the climate was being changed was taken to heart by the settler population as the United States claimed its independence. Thomas Jefferson, in his *Notes on the State of Virginia* (1787), reported as a result of his own research among the settler population that "both heats and colds are become much more moderate within the memory even of the middle aged." Late in his life, he called for a national network of weather observers to compile prolonged observations in order "to show the effect of clearing and culture towards changes of climate."[72] In

Philadelphia, William Currie pointed to the extent of the native forests to explain why the weather was originally found "less agreeable" in America than at corresponding latitudes in Europe. He compared the situation to that in the ancient civilization of China, where, by extensive alterations of the landscape, "the air, in very unfavourable situations, has been rendered exceedingly wholesome."[73] Italy, Germany, and England had improved their climates within historic times, according to Currie. The same could be expected in the United States: "When in the course of time, this continent becomes populated, cleared, cultivated, improved, and the moisture of the soil exhausted, . . . the bleak winds will become more mild, and the Winters less cold."[74]

By the last decade of the century, a widespread consensus had formed that deforestation and other improvements had already reduced the severity of winter cold in America and moderated other climatic extremes. The topic seems to have attracted experimental investigation after having surfaced in popular consciousness. Learned authors debated its magnitude and questioned whether it was altogether a good thing. Benjamin Rush, the most famous Philadelphia physician of the era and professor of chemistry at the University of Pennsylvania, addressed the question in a paper published in 1789. He accepted that "accounts which have been handed down to us by our ancestors" gave reason to believe that the climate had changed.[75] But the question was tricky to specify empirically because of the paucity of exact records from the early stages of colonization. Rush suspected that memories of the elderly, the source of Kalm's information, were unreliable, perhaps because people's perceptions of heat and cold altered as they aged. He concluded that there was no decisive evidence that winters had been colder before 1740 than after, but he agreed that the seasons had tended to merge into one another and the weather had become more variable in recent years. He accepted Williamson's assertion that clearing of forests and cultivation of the land were largely responsible for this. A few years later, the historian and physician David Ramsay made another assault on the question in his *Sketch of the Soil, Climate, Weather, and Diseases of South Carolina* (1796). Ramsay drew upon the long tradition of weather observations in Charleston, comparing contemporary records with those compiled by Chalmers in the middle of the century. He concluded that both maximum and minimum temperatures had moderated over the period, but that it was too soon to say whether this represented a long-term trend. He nonetheless reasserted the basic assumption that improvements in the natural environment would bring permanent benefits in terms of climate and health: "The advantages resulting to the temperature of the air, and

to the healthiness, as well as to the appearance of any country, from the art of man, inhabiting and cultivating it, are inconceivably great. We may, therefore, indulge the hope that our [climate] is progressively meliorating from permanent and encreasing causes." [76]

Samuel Williams's *Natural and Civil History of Vermont* (1794) reported that climatic transformation was "so rapid and constant, that it is the subject of common observation and experience. It has been observed in every part of the United States." [77] Throughout the country, winters had become shorter, summers less intensely hot, and the weather in general subject to more rapid variations. Williams, a member of the American Philosophical Society in Philadelphia and the Palatine Meteorological Society in Germany, also set out to explore the issue experimentally. He measured soil temperatures in uncut woods and in open fields and concluded that deforestation had measurably warmed the soil. He also measured the rate of evaporation of water from leaves, trying to estimate how much atmospheric humidity was reduced by removing forests. He understood that discoveries by Joseph Priestley and others had shown the importance of vegetation in restoring the air's suitability for respiration. His final conclusion was finely balanced, reflecting the consensus that change had happened but entering some reservations about its overall benefits.[78] Jeremy Belknap, a Congregationalist minister whose *History of New-Hampshire* (1812) investigated the question a couple of decades after Williams, agreed that trees had the virtue of purifying the air. He argued that New Hampshire owed the good health of its population to its rugged environment, including its forests.[79] Like Williams, Belknap was aware that trees had been shown to contribute to the healthiness of the air. These writers pointed the way to the emergence of a custodial attitude to the American forests, following in the wake of a conservation movement already established in the Caribbean.[80] But the campaign to preserve the forests emerged only slowly in the United States. Overall, the conviction prevailed that cutting down trees and cultivating the landscape changed the climate for the better. When Volney visited in the late 1790s, he reported that these changes were recognized by everyone and "have been represented to me not as gradual and progressive, but as rapid and almost sudden, in proportion to the extent to which the land is cleared." [81] Americans believed that they were civilizing their own nature, and doing so more rapidly than the Europeans had. In the nineteenth century, as agriculture spread to the Midwest, clearing the forest was regarded as the first step to rendering the land healthy and productive. On the Great Plains, it was commonly said that "rain follows the plough"—that

cultivation would change the climate in a way that would favor further settlement. This notion had first become established in the original thirteen colonies in the period when the nation was born.[82]

The idea of climatic transformation appealed to Americans' sense of their national destiny, their faith that providence was guiding the conversion of the wilderness into a civilized country. It also provided a way of responding to hostile remarks by European writers about the American environment and its effects. Buffon had led the campaign on this front with his assertion that nature in the New World had caused the degeneration of animal species transplanted from Europe. The same cold and humid conditions had stunted the growth and vigor of New World peoples, according to Buffon, who nonetheless saw a sign of hope in the prospect that the American climate might be changed to match that of Europe.[83] Robertson's strictures on the New World climate, particularly its effects on the natives, were especially severe. American nature had checked the growth of "the more noble animals" while encouraging odious reptiles and insects, "the offspring of heat, moisture, and corruption." The native peoples had been thwarted in their development, both physical and cultural, by the same cause. Afflicted with bodily weakness and a disposition to melancholy, they lacked the force of mind to take charge of their environment by domesticating animals or plowing the soil. Robertson did allow, however, that European settlers were taming the wilderness, which would permit them to escape the debilitating effects of the original climate and even offered the prospect of improving the character of the natives.[84]

Although Buffon and Robertson exempted European settlers from having had their constitution negatively affected by the climate, their criticisms were read as attacks on American nature, with worrying implications for the fate of the continent's civilization. Several American authors responded. In his *Notes on the State of Virginia*, Jefferson defended the climate of his state and insisted that it was already showing signs of being tamed by civilization.[85] In addition, he resisted the assertion that American climatic conditions had yielded degenerate forms of animal life. Jefferson had confronted Buffon personally on this matter in Paris, trying to clinch his point by sending across the Atlantic a specimen of an American moose, a mammal undeniably larger than any European equivalent. Nor would he accept that America had produced native human beings who lacked vitality and social sentiment; he insisted that Native Americans were not deficient by nature—they were simply at an early stage of social development.[86] As recent scholars have noted, Jefferson's sympathy for native people was not extended to the Africans enslaved on his own estate and throughout

the South. He adopted Hume's position that Africans were intellectually inferior to Europeans "by nature," and hence were likely to remain in the condition of slaves.[87] Apparently, it was more important to defend the reputation of Native Americans, presumably partly because they were products of the continent and its climate with which the new nation had cast its lot. As Charles A. Miller has put it, "Jefferson identified the human nature of America with its natural history, thus establishing a bond with the Indians that was inconceivable with the Africans."[88] A similar defense was mounted by Samuel Williams in his *History of Vermont.* He criticized Buffon as an armchair philosopher ignorant of the realities of American natives. "No such animal was ever seen in America, as the Indian M. de Buffon described in Paris," Williams insisted. It was not true that native people lacked sensibility, energy, or sexual drive: "Nature is the same in the Indian, as it is in the European."[89] Native Americans might have lacked cultivated morals, but they possessed the basic virtues of love of country and fierce independence—virtues that Williams thought all Americans should be proud to embrace. In contrast to the corrupting effects of European luxury and indulgence, the simple virtues of New World natives were said to derive from their closeness to American nature. These were therefore virtues that all inhabitants of the new republic might hope to share.

Jefferson, Williams, and others defended the native peoples because they identified them with the American environment.[90] The climate that had shaped them would inevitably set the conditions for the new nation's future, modified though it would be by the accumulated effects of cultivation. Volney, who fled to the United States in 1795 as a refugee from the revolutionary regime in France and left disillusioned three years later, wrote that the Americans had a peculiar pride in their climate. As far as he could see, it was altogether less desirable than that of Mediterranean countries, but Americans stubbornly defended its qualities. Volney thought that this could only be ascribed to self-interest and the simple fact that people got habituated to the conditions in which they lived. Their judgment was distorted by imbibing "a physical and moral atmosphere, which we breathe without perceiving it."[91] Americans themselves spoke of their newfound liberty as a "climate" or an "atmosphere," or as the direct result of the workings of nature on their moral constitution. Williams wrote that while European monarchs delayed the progress of reform, "nature was establishing a system of freedom in America."[92] Currie compared the ideal climate that Americans could expect to enjoy when the land was cleared with the political liberty they were already experiencing, having "already, in a great measure, regained the native dignity of our species."[93] Americans

were beginning to pride themselves on their climate, which they saw as the source of their virtues, especially the vigorous defense of liberty that had won their nation's independence.

Although it was articulated in arguments against European philosophers and developed in the context of the war of independence from Britain, this attitude was rooted in enlightened ways of thinking that had also found expression in British culture with the notion that climate could underpin national identity.[94] Americans understood their climate as integral to their destiny because they saw it as one of the means by which nature exerted its pervasive influence on human life at all stages of historical development. They were sometimes inclined to defend the virtues of the natives as products of the rugged American climate. Nature was thought to have given birth to heroically independent people who could inspire patriotic Americans as models of liberty. On the other hand, anxieties about the apparent weaknesses of the natives—which were unavoidable in view of their catastrophic susceptibility to diseases—could be allayed by the conviction that the climate was being changed by cultivation. European settlers prided themselves on having moderated the extremes of their weather by altering the landscape. Unlike the native peoples, they believed, they had taken hold of the environment around them and reshaped it to their needs. This would prevent them from sharing the natives' appalling fate.

Underlying these views about the American climate were attitudes to the relationship between nature and civilization that we have seen expressed in other contexts. The philosophers and historians who debated the role of physical and moral causes in history believed that nature was a shaping presence even in highly civilized society. But they did not believe that human beings were passive objects of natural forces. Rather, active intervention in the natural environment was an aspect of human nature itself. People—by their nature—acted on their physical surroundings. The same principle was at work in the commentaries of medical writers who advocated reshaping the landscape around settlements in the tropics. Civilized people could take action to redirect the forces of nature, for example by removing the sources of unhealthy air in marshes and forests. In doing this, they were not acting against nature, which enlightened thinkers would have considered impossible, but giving expression to an element in the natural constitution of humanity itself. Americans who asserted that they had derived their love of freedom from the environment of the New World were making a similar claim about the roots of human nature. Human beings were seen as the products of nature, even as they insisted on their prerogative to remold the surrounding milieu.

CONCLUSION

The Science of Weather

All these things which do not harmonize with one another do suit well with that lower part of creation which we call the earth, which has its cloudy and windy sky in some way apt to it.

ST. AUGUSTINE · *The Confessions*

You can't *build* clouds. And that's why the future you *dream* of never comes true.

LUDWIG WITTGENSTEIN · *Culture and Value*

AS WAS NOTED AT THE OUTSET, this is not a book about the history of meteorology as usually conceived. I have not been telling the story of how studies of the atmosphere assumed a scientific cast. There are already several books that give accounts of the development of meteorology in this period.[1] I have drawn upon them and refer to some of the same primary materials, but my basic aim has been different. I set out to explore how attitudes to weather and climate reflected experiences of the Enlightenment in Britain and its colonies. Pursuing the relations between these attitudes and cultural change, I have been concerned with general patterns of belief, not with systematic bodies of knowledge. I have not, until this point, raised the question of the scientific status of the ideas in question.

The question is, however, worth asking. It is worth considering whether a scientific study of the weather existed in this period and, if it did, what

kind of knowledge it produced. I cannot answer the question comprehensively at the moment—that would require another book—but I think the evidence I have gathered suggests the outlines of an answer. In the previous chapters, I have noted how people began to think that the weather reflected the regular course of nature, and how they hoped at the same time that diligent observation would reveal its laws. I have discussed how British investigators forged a sense of the national climate, in which the normal pattern of weather was viewed as a providential gift to the nation's prosperity and health. By way of a conclusion, I shall reiterate these points and introduce some new information to show how those studying the weather conceived of the goals of their investigation and the extent to which they believed they had achieved them. As we shall see, the picture shows both successes and failures. Extensive records were certainly accumulated, but I have already noted a number of ways in which studies of the weather failed to attain their most ambitious aims. Indeed, it could be said that this has continued to be the case ever since the eighteenth century. Meteorology continues to this day to grapple with inherent uncertainties; because it often falls short of its predictive ambitions, its scientific credentials are still called into question.

We can begin by asking, what did people in the eighteenth century believe would constitute a "science" of the weather? The word *science* was used in this period to mean a systematic body of warranted knowledge, and was not necessarily confined in its application to studies of the natural world. As the quotations from St. Augustine and Wittgenstein indicate, philosophers have long raised doubts about the very possibility of a "science" of the weather, in the strict sense of the term, holding that atmospheric phenomena occupy a domain of inherent uncertainty. In the late seventeenth century, it was often said that inquiries into the atmosphere should aspire to meet Francis Bacon's call for a "natural history" of the air. This presented an alternative to the classical Aristotelian conception of "meteorology," which had been concerned with the appearances known as "meteors." Aristotle's meteorology comprehended all phenomena that occurred in the realm below the orbit of the moon, including comets, shooting stars, and effluvia vented from beneath the earth, as well as things that would later be considered truly atmospheric. Many of these unusual or preternatural entities would also find a place in a Baconian natural history of the air, but they would be accompanied by more routine occurrences such as those we would recognize as "weather." Robert Boyle apparently felt he was making progress toward fulfilling the Baconian project in his posthumously published *General History of the Air* (1692). Boyle's work

included discussion of the temperature, pressure, and humidity of the air, along with its motions, its chemical effects, and its contamination by terrestrial effluvia. As has been mentioned, John Locke, who edited the work for publication, incorporated a portion of his own weather diary, indicating that a Baconian natural history could take the form of a chronological record of weather phenomena.[2] A few years later, the Edgiock diarist insisted that recording the properties of the atmosphere was the route to "a vast & extensive science."[3] Compiling a weather journal served the needs of natural history, marking a preliminary step toward the drawing of philosophical conclusions and the formation of scientific knowledge.

An additional aim of those who studied the weather, already expressed in the seventeenth century, was to predict it. Robert Hooke's instructions for compiling a weather journal, published in 1667, declared the goal of finding "laws" that governed the atmosphere.[4] This hope was boosted by Newton's accomplishments in celestial mechanics. It was expected that changes in the air could be made as predictable as the motions of planets and comets by the discovery of underlying laws. This expectation reflected the belief that divine providence expressed itself uniformly in natural processes; it provided a further inducement to engage in meticulous record-keeping over the long term. But the ideal was still unrealized in the early nineteenth century. More than a hundred years after Newton, no such laws of the atmosphere had been discovered. Richard Kirwan wrote in 1794 that the scientific method was "as yet in its infancy" so long as this remained the case.[5] The failure was something of a scandal, as if enlightened investigators were reduced to the condition of primitive men gazing in clueless wonder at the heavens. Luke Howard declared in 1818 that weather observers were still performing for their science the office undertaken for astronomy by the Chaldean shepherds. Notwithstanding the efforts of generations of such observers, he lamented, "Meteorology . . . is yet far from having acquired the regular and consistent form of a science."[6] Howard began to suspect it would never do so, that "from the very nature of the causes concerned," meteorology could never attain the predictive certainty of astronomy.[7] His worries on this score were to be echoed by other commentators in the course of the nineteenth century. Certainly, meteorologists of that period were well aware that the predictive goals of the previous century had not been achieved, though some thought they still might be if investigators would renew their efforts.

The consistent failure of eighteenth-century meteorology to accomplish what it had set out to do should feature in the telling of its story. While the steady efforts of many observers deserve to be acknowledged, it must be

recognized that they were never able to explain changes in the weather convincingly or to forecast them reliably. The issue has been discussed in relation to a later period. In her recent account of Victorian weather forecasters, Katharine Anderson has suggested that the history of meteorology reveals particularly well the problems surrounding science's establishment of its social authority, precisely because *this* science was relatively unsuccessful.[8] Similarly, for the eighteenth century, I have emphasized those respects in which the field fell short of its greatest ambitions, because they seem symptomatic of enlightened science encountering the limits of its capabilities. Thus, the failure of systematic research to predict the weather left the field open to prognostication by the traditional techniques of "weather-wising." The weather did not in fact conform to regularity, so fears of its extremes and anomalies continued to be voiced. Even the successes of eighteenth-century meteorology often had consequences that ran counter to the ambitions of enlightened intellectuals. Medical research showed the importance of an atmospheric sensibility that was not subject to rational control. The newly invented scientific instruments often seemed to be regarded by their users with a kind of superstitious awe. The shortcomings of meteorology as a science, which Anderson has uncovered in the nineteenth century, appear to have been rooted in the previous era.

The historian and philosopher of science Thomas S. Kuhn placed meteorology among the Baconian sciences of the early-modern period, applying his own criterion of a discipline that had not yet found a ruling paradigm and was therefore obliged to proceed by steadily accumulating observations.[9] There is no doubt that Bacon's inductive method provided a model for this field of inquiry, but to invoke it does not do the whole work of historical explanation, particularly when it comes to the collective organization of the enterprise. Scientific knowledge of the atmosphere requires information from dispersed observers to be concentrated at some central point. Bacon had in fact specified a hierarchical social structure within which any scientific investigation was to be conducted. But in the event, although individual weather observers were plentiful throughout the eighteenth century, coordination of their efforts was sporadic, with rather striking gaps in continuity. The Baconian enterprise seems to have been launched repeatedly—by Hooke, Boyle, and others in the 1660s, for example, and then again by James Jurin in the 1720s—only to slump into inactivity. In the 1770s, Henry Cavendish reported on the state of the Royal Society's meteorological instruments and recommended revised protocols for using them.[10] A weather journal began to appear regularly in the *Philosophical Transactions*. The following decade, observational initiatives were

launched in France, Germany, and elsewhere on the European continent. Although these have been hailed as unprecedented accomplishments, the projects lapsed again after a few years.[11] In 1801, Kirwan repeated the call for groups across Europe to communicate their observations on a regular basis. In 1823, John Frederic Daniell made severe criticisms of the observing practices in the Royal Society. It appears that the enterprise of organizing meteorological observers had to be kick-started repeatedly every couple of decades. Realizing this, we might be inclined to question the assumption that these initiatives should be identified with one another as part of a continuous history. If the deep story is one of the steady progress of observational knowledge, why was it so difficult to maintain momentum? Why were there so many years when nothing seems to have been happening?

To begin to answer these questions, we need to place each individual initiative in its appropriate context. It is far from clear that initiatives as far apart chronologically as the 1660s and the 1830s should be considered parts of the same project. Hooke's publication in the 1660s of a standard form to record weather observations was consistent with Bacon's vision of the process of induction, which required instances of phenomena to be assembled in tables and subjected to the gaze of a superior intellect who could draw axioms from them.[12] Hooke understood the need for observers to use standardized instruments, but he largely relied on the market among commercial suppliers to bring this about. He was looking for observers to submit diaries of their observations that would extend, if possible, over fairly long periods. He was not concerned specifically with the timing of observations, nor with where they were made; the only qualification required of observers was prolonged local knowledge. In retrospect, from the vantage point of later organizational projects, the vagueness of Hooke's stipulations would come to seem unpardonably lax. But Hooke understood that the Royal Society operated in a situation in which individuals' contributions were voluntary and rewarded only in the currency of peer approval. Weather observers were almost all drawn from the class of gentlemanly virtuosi; they were accustomed to setting their own hours for their avocations, not to being instructed as to when they should do their work. They were oriented toward the enterprise of chorography, or local descriptive geography, even while they also participated in the wider republic of letters.[15] Hooke appreciated that the project he was launching had to rely on this culture of local expertise and virtuoso sensibility if it was to achieve anything.

Turning to the other end of the period, it is clear that Daniell and other meteorological reformers of the early nineteenth century were striving for a much higher degree of precision in measurement and a regularity in

the timing of observations that would bring work methods into line with the ideals of the industrial age. It seemed scandalous to Daniell that the variation in timing of the Royal Society's daily observations was "obviously regulated by nothing but the observer's night-cap."[14] Another reformer, Sir John Herschel, looked to men subject to military or naval discipline to find observers who would keep more regular hours. Instructing naval officers on the procedures to be used to compile meteorological registers, Herschel noted, "Irksome as it may be to landsmen to observe at 3 A.M., the habits of life on shipboard render it much less difficult to secure this hour in a trustworthy manner."[15] Maritime routines, military habits, even the regular devotions of members of religious orders, provided useful precedents for the more meticulous regularity that Daniell and Herschel sought to introduce into weather recording. And much else had changed in the century and a half since Hooke had published his invitation. Learned societies had developed a more systematic concern with the climate as a national asset having crucial effects on agricultural productivity and the health of the population. Much more accurate instruments were available, through improvement of the skills of instrument makers and a considerable expansion in the market. The culture of precision measurement had been placed at the service of nation-states in such enterprises as the cartographic surveys of the eighteenth century. Graphical methods had been devised by Alexander von Humboldt and others to map physical and biological variables across extended topographical domains. Herschel and others sought to capitalize on these developments to organize weather reporting on an unprecedented scale through the British Association for the Advancement of Science, beginning in the 1830s. They perceived the possibility of mobilizing a network of disciplined observers dispersed across an extensive geographical area. Meteorology, along with studies of terrestrial magnetism and the oceanic tides, became a means for the scientific mastery of geographical space. Men were to be employed to engage in the "extensive fagging" that such ambitious projects demanded.[16]

Situating these organizational initiatives in their specific historical contexts, we can begin to see what factors determined their successes and failures. Historians of science in recent years have repeatedly noted the social dimension of the creation of natural knowledge, how it relies on the distribution of skills and the coordination of actions as well as on the dispersal of material instruments. Histories of meteorology have already given significant attention to instruments, especially in relation to standardization of scales of measurement and advances in precision.[17] But there is still a need to widen the angle of view, so that more can be learned about how

apparatus was actually used. Attention needs to be focused not just on events at the center of the observing network, but also on what was happening at the peripheries. This means considering both the ambitions of those who sought to recruit observers and the characteristics of the individuals they tried to enroll. Weather observers such as John Locke, Gilbert White, or even Luke Howard were largely following their own agendas, indulging their own gentlemanly curiosity in accordance with their own routines. They were, according to Howard, "gentlemen possessing . . . domestic habits, [aiming to] . . . agreeably fill up a portion of their daily leisure." [18] Their records, as Kirwan acknowledged, were inevitably subject to interruption "by death, sickness, or the common cares of life." [19] From the vantage point of Herschel and his colleagues in the age of scientific and political reform, eighteenth-century practices seemed to be mired in stagnation and amateurism. Historians should not succumb uncritically to this retrospective point of view, but some recognition of the limits of the organizational infrastructure of the time does seem appropriate.

Lacking continuous coordination, weather observers in the eighteenth century set their own objectives. As we have seen, their motivations were partly personal and partly connected with a sense of public duty. They shared the conviction that the way to make progress was through the compilation of a "longitudinal" (chronologically extended) record at a particular place. Their object, as Howard put it, was "a knowledge of the peculiar features of their own climate, and of the facts which, properly arranged, would form its *history*." [20] Even while they hoped for some form of coordination with other observers, their main focus was on maintaining the record at their own location in order to grasp the temporal connection between weather events. In 1794, Kirwan was still proclaiming that meteorology would mature as a science when the problem of the succession of atmospheric phenomena was solved, "the order in which they present themselves and succeed each other" having hitherto eluded research.[21] This chronologically extended kind of knowledge continued to draw the interest of investigators well beyond the eighteenth century. Howard's decades-long search to tie down the moon's influence on the weather exemplifies it, as does Kirwan's study of the patterns of the seasons. Kirwan devoted considerable effort to finding rules for forecasting a dry or wet summer or autumn from the weather of the preceding season. The project necessarily required a prolonged series of observations; he made his own at his home in Dublin in the 1790s, and he also drew on those of John Rutty and Thomas Barker from previous decades.[22]

At the same time, Kirwan showed an interest in the spatial dimension of weather phenomena, anticipating in some ways later developments in

the science. He complained about observers who failed to pay attention to conditions at distant locations and called for a "*conspiracy*, if I may so call it, of all nations" to compile simultaneous observations from across Europe.[23] He appreciated that standardization of instruments was of vital importance to this campaign, which he saw as an appropriate expression of an advanced stage of enlightenment on the European continent. But he had little idea what form atmospheric phenomena would take if they were studied over a geographically extended area, or even what size they would turn out to be. Pulling together some of the available data on the subject in 1801, Kirwan mentioned the mapping of the Gulf Stream by Benjamin Franklin and others in the 1780s. Perhaps atmospheric currents would be found to have a size and speed similar to those in the oceans? Perhaps they could be traced in the record of barometric measurements made at the same time in different parts of the Russian empire in the 1760s? Or perhaps much larger-scale motions of the air could be found, at a truly global scale, revealed in the record of winds experienced a few days apart in St. Petersburg and in the Pacific Ocean? In view of the uncertainties of what Kirwan admitted in 1801 was "this obscure subject," he seems to have felt that more secure knowledge of the geographical aspects of weather could be sought by revising the ancient doctrine of climates.[24] Fourteen years earlier, his *Estimate of the Temperature of Different Latitudes* (1787) had studied how average temperatures at various places could be predicted from the angle of incidence of sunlight on the earth's surface. Kirwan still felt the lure of the classical concept of climates corresponding to zones of latitude. It was more straightforward to approach the problem of relating climate to geographical space in this manner than by grappling with the protean phenomena of weather.

Kirwan stood at a turning point in the development of geographical knowledge of the atmosphere. While looking back to ancient ideas, he also pointed forward to what happened later. In the course of the nineteenth century, large-scale movements of the air were mapped with considerable success. Storm systems, anticyclones, and (in the early twentieth century) weather fronts came to be identified, their motions charted and eventually predicted. These developments depended on the crucial technology of the telegraph, and later on wireless communication, which allowed for the rapid collection of simultaneous observations from widely dispersed points. It was only possible to begin to map such weather phenomena when human messages could move more rapidly than the air itself. A series of visual techniques was then developed to trace on paper the motions of air masses shortly after they had occurred, and eventually to offer predictions of how they would behave in the coming hours.[25] At the beginning of the nineteenth

century, this was simply inconceivable. For all that they sought to collect observations from dispersed sites, meteorologists of that era had little idea of the spatial scale of the phenomena they were searching for. And as regards the dimension of time, their attention was focused on changes measured in days, months, or seasons rather than in hours. Only in the 1850s, with the establishment of telegraphic networks to convey weather information, did meteorologists begin to consider events happening on a much shorter timescale across a much larger expanse of geographical space.

The significance of techniques for mapping weather systems in nineteenth-century meteorology, and their prominence in the public profile of weather science today, can lead to an overemphasis on the eighteenth-century developments that pointed in this direction. For example, Franklin's work on the Gulf Stream was preceded by his tracking of the path of a nor'easter storm up the eastern seaboard of North America. The insight was an original one, recalled later as a pioneering attempt to understand the dynamics of storms; but it was not typical of studies of the weather in the period.[26] Insofar as people of the time were investigating the spatial dimension of weather phenomena, they were doing so without any inkling of the later theories of atmospheric systems. Their efforts generally require reference to contexts other than meteorology to be understood historically. For example, Edmond Halley's important map of the trade winds, produced in the 1680s, served the enterprise of improving techniques of oceanic navigation, a project that also issued in his simultaneous work to map magnetic variation throughout the Atlantic.[27] Weather instruments were often taken to sea—as tools of navigation, to warn of impending storms, and to collect observations from far-flung places.[28] But this did not yield any significant knowledge of large-scale atmospheric phenomena. Weather apparatus was also incorporated in the practices of geodesic and cartographic surveying in the eighteenth century. Thermometers and barometers formed part of the equipment of Mason and Dixon, drawing the line between Maryland and Pennsylvania in the 1760s; of William Roy, conducting the Paris–Greenwich triangulation in the 1780s; and of Delambre and Méchain, measuring out the meridian of Paris in the 1790s.[29] But the purpose of these measurements of air temperature, pressure, and humidity was to eliminate their effects on the surveying instruments. While the surveyors did forge a kind of connection between meteorology and geographical knowledge, they were basically trying to exclude the weather from interfering with topographical mapping, rather than to map the atmosphere directly.

As a number of historians have noted recently, instruments were used in innovative ways in the eighteenth century to produce knowledge of

geographical space.[30] The accumulation of such knowledge was a significant aspect of scientific development in the period. As Europeans extended their influence worldwide, they deployed techniques of navigation, cartography, natural history, and other sciences to master the spaces they encountered.[31] Primarily, these methods were devoted to charting the oceans and the land—to rendering the seas navigable, physical terrain accountable, and its biological inhabitants classifiable. Insofar as the space of the atmosphere came to be known, however, it was largely by techniques that demanded that the observer be stationary, rather than in motion. Knowledge of the air, the traditional domain of meteorology, remained mostly the preserve of settlers, rather than of travelers. As we have seen in connection with colonial outposts, fairly prolonged residence was required in order to gain knowledge of the climatic characteristics of a place. What was sought was information about the patterns of the seasons and how they related to agriculture and human health. This knowledge demanded observation in a localized spatial domain over an extended chronological period.

This was the most significant accomplishment of eighteenth-century weather science. What was produced was not knowledge of weather systems in the nineteenth-century mode, but rather information about the climates of regions, whether they were provinces, nations, or continents. As we have seen in the British case, the assembled records of the weather contributed collectively to a new consciousness of the national climate, identified with the regular patterns of weather experienced on the island. The concept was put to use in political and historical writing, in medical discourse, and in journalism. It amounted to a geographical expansion of what the term *weather* referred to, broadening it out from something experienced at a single place or in a very limited area to something that could explain the character of a people, their state of health, and aspects of their historical destiny. Although the concept was certainly geographical in a general way, it did not lead to any actual maps of the atmosphere. Talk about a national climate assigned a certain kind of weather to a certain territory, but it did not explain what happened in the atmosphere to cause it. Looking back from the vantage point of the following century, one could say that it did not get to grips with the spatial extent of atmospheric phenomena themselves. These were only properly comprehended when communications technology improved.

From the retrospective point of view, one could certainly deliver a negative judgment on the progress of meteorological science in the eighteenth century. It could be said that the data being accumulated led to no dramatic theoretical advances. A new understanding of the dynamics of the atmo-

sphere was achieved beyond the horizon of the period, in a way that seems discontinuous with the earlier information gathering. That enterprise was proceeding not so much in the wrong direction as in the wrong dimension, collecting information about chronological sequences of weather in particular places, whereas what was needed was an understanding of spatially extended—and rapidly changing—atmospheric formations. But such a judgment would be one-sided and arguably unhistorical. It would ignore what eighteenth-century investigators were trying to accomplish, their own understanding of the imperatives of their inquiry. As we have seen, they catalogued the weather in their own localities as a contribution to an overall knowledge of the climate in which human life was lived. Their accumulating knowledge of the weather participated in a widening geographical awareness, the climate of a nation being seen as an attribute of its geography and defined by contrast with conditions prevailing elsewhere. These observers also saw their inquiry as consistent with historical change as they understood it. Pursuing their task over the course of years, or even decades, they were acting in accordance with a vision of history as continuous progress. They worked to recuperate vernacular knowledge for the purposes of science, exploiting popular traditions in a way that reflected their notions of cultural improvement. As knowledge of the atmosphere steadily accumulated, it was thought, the weather would be civilized—reduced to norms and regular laws, even altered to be more moderate and less threatening—as part of the overall progress of civilization.

In these respects, the science of weather in the eighteenth century was a *reflexive* enterprise, mirroring investigators' awareness of their situation and context. Eighteenth-century scientific practitioners saw themselves as participants in an expanding domain of enlightenment. They expected empirical knowledge to increase hand in hand with material progress. But at the same time, part of the experience of enlightenment was the understanding that the process was neither complete nor unopposed. It was appreciated that scientific rationality confronted many traditional beliefs and customs, and indeed that its powers were limited even when it came to determining the behavior of a single individual. The persistence of traditional weather lore, proverbs, and sayings, the survival of what were viewed as "superstitions" among the populace at large, reminded investigators that their society had not been totally enlightened. Particularly when anomalous or extreme weather occurred, the project of reducing the climate to providential regularity seemed to be thwarted. Such incivilities in the atmosphere tended to evoke incivilities also among the human population. The resurgence of superstitious fears forcefully conveyed to enlightened

intellectuals the fact that cultural change in the society around them was only partial. Growing knowledge brought with it an enhanced understanding of how much human beings depended on their emotions and bodily health. Cultural change also raised people's awareness of the diversity that sheltered under the rubric of "human nature," the cultural localism that persisted in the face of attempts to extend knowledge across the globe. In these ways, knowledge of the weather and climate reflected an awareness of the intrinsic limits of enlightenment, the incompleteness that was an inherent part of the movement as it was historically experienced.

Eighteenth-century thinkers on these matters expressed a degree of historical self-consciousness that sometimes eludes us today. They initiated systematic inquiry into the influence of climate at different stages of social development. Pursuing this, they recognized the inextricability of human society and its natural environment, the fact that advancing civilization did not free humanity from its dependence on nature, but rather ramified and deepened the connections between them. It was a lesson reinforced by the attempts of intellectuals to extend the domain of scientific reason over the weather and by the limited scope of their accomplishment. And it is a lesson we might feel is still worth attending to.

As I was finishing this book, in the late summer of 2005, Hurricane Katrina struck the Gulf Coast of the United States with devastating impact on Louisiana and Mississippi. Attending to the news and commentary from New Orleans and elsewhere, I found it hard not to think of parallels to eighteenth-century weather disasters. Some journalists commented on the resurgence of apocalyptic fears among the population affected by the hurricane. Sometimes they treated these beliefs sympathetically. Charles Passy in the *Palm Beach Post* sounded out preachers and environmentalists and found them purveying essentially the same message: "If we are more vulnerable, it's perhaps because we're reaping what we've sown."[32] Deborah Caldwell of *The Advocate* in Baton Rouge noted, similarly, that Christian conservatives and leftist environmentalists were both inclined to view Katrina as a punishment for human transgressions.[33] In a more sophisticated analysis, Edward Rothstein in the *New York Times* remarked on the persistence of a "scientific/moral theodicy in which human sin is still a dominant factor."[34] Some commentators, it was clear, did not so much endorse these beliefs as exhibit them as specimens of resurgent superstitions. The widespread belief that the hurricane constituted a punishment was to be viewed as itself a sign that cultural primitivism was reemerging. This theme complemented the stories about the collapse of social order among some of the population abandoned in New Orleans, though it later turned

out that many of these stories were exaggerated. Without denying the specific roots of these reports in contemporary American social anxieties and racial tensions, I could not help noting the resonances with my own studies of the eighteenth century. At that time, as I have shown, unusual or catastrophic weather events focused worries about science, enlightenment, and modernity. The regular climate was viewed as benevolent, a force that integrated human beings with their environment, that answered to their needs, and could even be modified by the progress of civilization. But occasional weather disasters brought out profound doubts about progress, about its limits and its drawbacks. My studies have indicated how some of the cultural responses to Hurricane Katrina have deep roots indeed. The weather apparently still has the power not just to disrupt our material lives, but also to make us reflect on the shallowness of civilization in our incompletely enlightened age.