Thirty Percent Chance of Enlightenment

A journey across India in search of the meaning of water

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I'm watching the Weather Channel,
Waiting for the storm.

--Sheryl Crow

The pitch

All travel stories set out with good intentions. The best, though, involve a shipwreck. The good intentions run onto hidden rocks not on the chart. The old, familiar self is wrecked, and drowns. A new self fights his way to the surface, blinking and astonished, changed in utterly unpredictable ways. This is just another of those stories.

My editor at *National Geographic* called me, the first of several calls between me at home in Vermont and the upper echelons of the magazine clustered around the speakerphone in Washington. They were looking for someone to write an article about weather forecasting, he said. Was I interested?

I'd say I was. I had just finished reading Alexander Frater's book *Chasing the Monsoon,* in which Frater followed the Indian monsoon from its landfall near Trivandrum, at the southern tip of India, up the west coast, trying to gauge the depth of the connection between the monsoon and the culture it touched and helped to create.

He met wealthy women from Bombay traveling to southern India to stand knee-deep in the ocean as the monsoon burst over them. He met a famous Indian poet who told him, even as the power was flickering on and off, that the monsoon was "a terrifically sexy time"--a time of weddings, of parties, of the sense of renewal, fertility, rebirth. He followed the monsoon front making its way up India as it brought joy, relief and chaos like the spirit of life itself. He ended up in the wettest place on Earth, a small town on the highlands in Assam called Cherrapunji where it rained so much, and so hard, that tiny waterfalls sprang up everywhere. Between downpours the air was full of rainbows, and more than three hundred different varieties of orchid flourished in the nooks and crannies, as if the rainbows had touched down and found expression in petal and leaf.

And it all began, according to Frater, with the head meteorologist at the observatory in Trivandrum trying to keep his dignity and his science intact while everyone in India from the Prime Minister on down was phoning him, demanding "Where is the monsoon?"

The monsoon forecast, I argued to the assembly of inclined editorial ears in Washington, is the most dramatic act of forecasting in the world, an epic of meteorology, complex almost beyond calculation, significant to a degree that Westerners can't comprehend. The Asian monsoon affects a fifth of the world's population. It provides almost 80 percent of India's annual rainfall. A weak monsoon condemns much of the country to drought and famine on a scale unimaginable in the West. A heavy monsoon, however, causes disastrous flooding: cities are swamped, and in the rural areas hundreds of people drown or are swept away in mudslides. Monsoon floods in 1978-79 destroyed nearly 4 million homes, and killed 2,800 people and 200,000 cattle. The following year, a failed monsoon endangered the lives of 130 million cattle and more than 200 million people by starvation and disease.

The plan I proposed was pretty straightforward. I would go to Trivandrum, watch the monsoon come ashore, see if it was really the transformative experience Frater had described, and then interview the India Meteorological Department to find out why the monsoon is so difficult to forecast accurately, and why an accurate forecast is so important. Frater had chased the monsoon; I would chase Frater. While I was at it, I might also check out an independent organization in Bangalore called the Centre for Mathematical Modelling and Computer Simulation (C-MMACS), which was making forecasts using some kind of fancy computer technology called a neural network.

The computer ingredient was important because weather forecasting, it seemed to me, was our most developed attempt at one of the epic human quests: to see into the future.

In no other realm of prediction, not even the stock market, have so many people invested so much time, energy, money, ingenuity, and computing power. The budget of the U.S. National Weather Service alone was close to a billion dollars a year, to say nothing of the ballooning--so to speak--commercial forecasting outfits, and the meteorological enterprises of all the other governments of the world. The computer currently in use at the National Weather Service (which consisted of two parts, charmingly called Frost and Snow) had been ranked number twenty-five in the world's Top 500 Supercomputers. It was said to be able to handle 8.6 trillion calculations—15,000 years' work with a handheld calculator—in a second. Was it really possible, given such ambition, such extravagant tools, to break through that invisible wall and be the seer, the oracle?

National Geographic likes ideas on an epic scale, and I was hired. In a sense I had created the future that I wanted. In a sense, too, we jointly made an act of prediction: I'd go to India, I'd see the monsoon, I'd interview the meteorologists, I'd come back and write the story.

It didn't quite work out like that.

Nobody foresaw that India and Pakistan were about to move to the brink of nuclear war. Nobody foresaw that meteorologists, the calmest and most temperate of people, were about to behave in an utterly irrational fashion. And nobody, least of all me, foresaw that the real story would not be about weather forecasting at all.

Storm Week

I began working on the story in late fall, and over the next few months I fell in love with weather. I came to recognize an entire menagerie of clouds--twisting, changing, piling, dispersing, the solitary and the social. Driving to work, I craned my neck to watch fat round lenticulars sitting astride the Green Mountains, and late one afternoon I was sitting in a diner near Denver airport and noticed that everyone in the place was staring in the same direction: the sky above Denver and the Rockies was a stunning panorama of broken blue-grey-silver clouds, here solid, there ruptured by sunlight, here pregnant with rain, there festooned with virga, the trailing fronds of cloud that are a sign of rain that falls but evaporates before it reaches the ground. The clouds were the mountains, inverted. A storm was moving up from the south, and everyone in the diner turned to watch. A single bolt of lightning struck south of Denver, and around it the virga were so low they brushed the ground, like the belly fur of a gray Persian cat.

At the same time, something strange and apparently contradictory was going on: I was becoming disenchanted with weather forecasting. The science was impressive, yes, but the more I found out about meteorology, the more it seemed to miss the point.

This strange disconnect first struck me one midnight in the dead of winter, six thousand feet up on the top of Mount Washington in New Hampshire, where a weather observer named Steve Bailey and I were getting ready to go out into a hurricane.

The wind was peaking above 90 mph. Chunks of rime ice were breaking off the television antenna, flying across the mountaintop, and exploding against the thickened Mount Washington Observatory windows. In April of 1934, volunteers in the observatory, at the time little more than a wooden shack chained to the bare rock, measured a wind gust of 231 mph, still the highest wind speed ever measured on the surface of the earth. That night it felt as if at any moment the building might be blown clear off the mountain.

Steve suited up, put on his goggles, hung around his neck a small flashlight with a red beam that wouldn't mess up his night vision, and picked up an empty precipitation can, a metal cylinder as tall as his hip for catching and recording rain or, tonight, blowing snow.

Steve was one of three weather observers who, along with a meteorologist, staffed this mountaintop observatory, the only such station east of the Mississippi. He was about to observe the current weather conditions in the old-fashioned way: by going out into them.

To measure the recent precipitation, he had to collect the precipitation can, which was set up as far as possible from the windshadow of the building--nearly 100 yards away—and replace it with an empty one. If I hadn't been there, he would have gone out alone, as usual, while the other three slept.

"The night person knows that no one else is going to find him for a while," he chuckled dryly. "If the winds equal your weight, they can knock you down. If they reach 160, I'm in trouble."

He propped open the inner door and cradled the can against his chest.

"Do you want help carrying it?" I asked.

"No, thanks," he said briefly. "I'm going to run."

And he did, off into the darkness, the faint glow of his flashlight receding across bare mountaintop.

I set off after him, and--wham! At this velocity, the wind stopped me dead in my tracks, leaving me like a frozen surfer, knees bent, hands out. The wind felt like solid air. Underfoot, the rime ice that normally encrusted the mountaintop in small Indian's-head crests had melted and refrozen into tiny glazed ripples. No traction at all. Another gust drove me sideways, and I went down on one hand. Steve's flashlight was a glowworm, somewhere ahead in the dark. As I struggled to my feet to try to follow him, he had already switched cans and was running back, hugging the other cylinder as if this were some strange sport played above the Arctic Circle--Reykjavik rugby, perhaps.

I waded and slid back in through the double-doors after him, gasping and stunned. The observatory boasted having the worst weather in the world, but the truth was, this midwinter hurricane was the most exciting weather I'd ever been out in. I've seen the slender grey goose-neck of a waterspout reach down from a solitary cloud over the Caribbean. I've seen the leaden sky of Belgium turn a dull orange overhead as the father and mother of all thunderstorms was gathering. I've seen palm trees bent sideways by wind and flying spray when a near-hurricane hit San Diego. And when I was twenty-six, trying to decide whether to leave a dull teaching job to try to make my way as a writer, I got caught in a downpour in the tiny English city of Wells, a cloudburst so spectacular that the roads running down into the city from the surrounding hills turned into mountain torrents, flooding the city center, leaving old ladies stranded on street corners and riddling the downtown with stones downwashed from the steeply-sloping fields. It was so exciting I called in to the school, quit my job and spent the afternoon pushing cars out of the small lakes that had formed everywhere. None of those weathers, though, had taken my breath away to this extent. None had seemed so much like the casual, overwhelming movement of a divine hand, the true nature of Nature expressing itself and leaving me both thrilled and abashed.

Indoors, with boots, coat, mittens and goggles off, I found Steve working his slide rule.

"Dewpoint of 23.4 converts to what in Celsius? There's a lot of talking to yourself in this job. Height of cloud above station...seven thousand to eight thousand feet, that's an eight...air pressure...three point one...then we convert that to inches...cloud cover...call that a two...high today was a 29.9...depth of snow on the ground--that's a <u>real</u> guess..."

After maybe fifteen minutes, Bailey turned to the old black and white monitor and typed his message to the National Weather Service:

250 68G75K20SM BLSN BKN070 OVC180 M02/M05...

The modem twittered, compressing that extraordinary weather into alphanumeric data.

That was my first moment of doubt about forecasting: no matter how spectacular the weather might be, the meteorologist's job was to convert it to data, to make it part of the vast, global effort to generate a blizzard of data that, if dense enough, would perhaps depict the opaque future, like one of those meaningless drawings that turns out, if only you can focus your eyes properly, to be a picture of the Empire State Building.

(Later I discovered that the observatory's weather was so remarkable, so anomalous that, if included in the National Weather Service's calculations it would have skewed the overall weather picture for northern New England. "We throw it out," a forecaster told me.)

Every forecaster I met had a tale of some spectacular weather event that left him awestruck and indelibly fascinated by the sky--but over time, that fascination seemed to have been left behind as if it were slightly childish, to be replaced by a drier terminology, a life among more routine weather. Steve Bailey, working on rime ice under hurricane conditions, taking his measurements on mahogany-and-brass instruments, was an exception: most meteorologists, I discovered, work in darkened rooms full of computers, the windows blinded to cut down the glare on the screens.

The story that revealed the most about a meteorologist's view of the world was told me by D.J. Patil, a very bright young guy using chaos principles to identify areas in the atmosphere where weather was likely to be most unpredictable. He was at the University of Maryland, and a few months previously he had set up a conference to discuss using their methods to forecast severe storms.

The meeting was held in a windowless conference room in the heart of a building, all the better to throw PowerPoints and laptop images up on screens. Partway through the gathering they thought they heard some commotion outside, but they didn't pay it much attention. When the meeting was over they discovered that an F5 tornado had just ploughed across campus, right past their building.

"It was the weather event of the century," DJ laughed, fully aware of the ironies, "and I missed it!"

The other aspect of weather forecasting—in the United States, at least—was that it stirred up what the poet John Engels has called "weather-fear." Even the government-run NWS sees its job as responding to a series of potential threats, and the private commercial weather operations ratcheted up this anxiety, acting as if the weather was our enemy, and without its services we were constantly only moments away from catastrophe.

Let's take the Weather Channel, for example, which has talked its way into virtually every cable package and every airport terminal in the country. I decided to take a close analytic look at it on a perfectly ordinary New England day.

The first thing I noticed was how small weather is on television, which as a medium both exaggerates everything, and trivializes everything. In reality, the sky is a kind of wilderness: unreachable in a sense, intangible, unpredictable, inhospitable, constantly calling for description and then defying it, changing every instant, vast, literally superior, humbling. The Weather Channel reduces this wilderness to screen size. Going outdoors and looking up induces awe, but TV weather has us looking

across or down at the small screen showing the satellite photo, the shunting smear of rain on the Doppler radar.

Looking more closely, I noticed that the screen had a strange split personality. Down the right and across the bottom, in unexciting numerals, ran a border displaying the data of the local weather: highs, lows, the undescriptive abbreviations that are a poor substitute for conversation about the weather: partly sunny, partly cloudy. These numbers all stressed that science was at work—the science of observing and measuring weather conditions, and by implication the equally exact and credible science of the short-term forecast. The numbers bore a distant resemblance to the Big Board ticker that runs under the screen on the business channels. This, the Weather Channel implied, was information you could take to the bank.

On the big screen, though, was something much more compelling, something to grab us by the throat and take our breath away: a promo for Storm Week.

Over and again it showed clips of weather's greatest hits: the two sections of a roof blowing off a building, palm trees whipping and bending, ocean spray. Weather has changed in the last quarter-century, in a way that has nothing to do with global warming or tinkering by the Russians. It has become steadily more threatening. A common or garden thunderstorm has now become a Storm, and has become the subject of alerts and warnings that were not possible in 1975—but might also not have been thought necessary. Now storms are news, and more than news: storms have become characters in the continuing national drama. Storms—perfect storms, twisters, hurricanes—have emerged from the shadows into the lights of Hollywood the way sharks did in the age of Spielberg: bad weather has become the Nazis, the Reds. It has become Killer Weather. Conveniently so: in an age of political sensitivity, we're running out of villains. Weather provides the perfect villain: nobody gets offended, nobody sues, nobody boycotts advertisers. In an age of Safe Sex, weather is Safe Violence.

Hardly surprising, then, that the boundary between weather report and fiction get blurred. Shortly afterwards, the banner on the AOL Welcome page read: "The Perfect Firestorm. Two mammoth fires merge, creating `50-mile wall of flames.'" Anyone following the link to the actual story found the fire incident commander explaining that once the two fires merged, they became in some respects easier to fight; and the fifty-mile wall of flames was in an area so remote and sparsely inhabited that the 300,000 acre fires had destroyed only 185 homes. Very bad news for those involved, of course, and hard for the firefighters too, but hardly the holocaust that the headlines suggested.

All in all, the weather message was less of a forecast than a warning: dangerous weather was lurking over the horizon, and any moment now that might be our home getting blown apart, that could be us running from a fifty-mile wall of flame. Better stay tuned.

Hosannas to the miracle

After six months of hearing weather described as if it were the Red Menace of the new millennium, it came as a refreshing, not to say startling change to read what Indians wrote about the monsoon.

First of all, a quick definition. A monsoon is a seasonal weather pattern, typically involving rain, that reverses itself. It happens on such a scale that, even though the word *monsoon* comes from an Arabic word for "wind," we're not talking about a single weather, such as a storm, not even a huge storm like a hurricane.

In May-October, monsoons sweep over many of the land masses of the northern hemisphere. (Even the southwestern United States has a small one.) In India, for example, as the early-summer sun heats the land, heated air rises in a gigantic thermal that extends as far north as the Tibetan plateau. The rising hot air draws in cooler low-level air from over the sea—and, given the way the earth rotates, from over the Arabian Sea to the west of the subcontinent. There's an eastern arm of the Asian monsoon, too, which makes its way at roughly the same time up through southeast Asia toward Bangladesh.

In November-March, the southern hemisphere's summer, monsoons sweep over land masses in the southern hemisphere, such as Australia. In South Asia, then, the monsoon seems to reverse itself, as if migrating, or changing its mind, heading northeast in summer and southeast in early winter.

To give a sense of the full meaning of the monsoon takes language more lyrical than the terse, dry rip-and-read prose of the National Weather Service. Consider this description by Khushwant Singh, a former Indian Member of Parliament, in *Monsoons*, edited by Fein and Stephens.

"The sun goes on, day after day, from east to west, scorching relentlessly. The earth cracks and deep fissures open their gaping mouths asking for water, but there is no water—only the shimmering haze at noon making mirage lakes of quicksilver."

Then false hope arises: clouds form, but it is only a dust storm.

"The fine powder begins to fall. A solid mass of locusts covers the sun. They devour whatever is left on the trees and in the fields. Then comes the storm itself. In furious sweeps it smacks open doors and windows, banging them forward and backward, smashing their glass panes. Thatched roofs and corrugated iron sheets are borne aloft like bits of paper. Trees are torn up by the roots and fall across power lines. The tangled wires electrocute people and set houses afire. The storm carries the flames to other houses till there is a conflagration. All this happens in a few seconds. Before you can say Chakravarti Rajagopalachari, the gale is gone. The dust hanging in the air settles on books, furniture and food; it gets in the ears, throat and nose."

Finally, the monsoon arrives:

"[An] ebony wall is coming up from the east. A flock of herons flay across. There is a flash of lightning that outshines the daylight. The wind fills the black sails of the cloud and they billow out against the sun. A profound shadow falls on the earth. There is another clap of thunder. Big drops of rain fall and dry up in the dust. A

fragrant smell rises from the earth. Another flash of lightning and another crack of thunder like the roar of a hungry tiger. It has come! Sheets of water, wave after wave. The people lift their faces to the clouds and let the abundance of waters cover them. Shops and offices close. All work stops. Men, women and children run madly about the streets, waving their arms and shouting `Ho, ho'—hosannas to the miracle of the monsoon."

For a while, at least:

"With the monsoon the tempo of life and death increases. Almost overnight grass begins to grow and leafless trees turn green. Snakes, centipedes and scorpions are born out of nothing."

Floods sweep away roads, houses, railway tracks, bridges. At the same time, the croaking of frogs, insects everywhere, the singing and laughter of girls on swings in mango groves—the sounds of the monsoon have been echoed in some of India's most famous ragas.

"The monsoon is the most memorable experience in the lives of Indians. Others who wish to know India and her people should also see its impact on the country…. It has to be a personal experience because nothing short of living through it can fully convey all it means to a people for whom it is not only the source of life, but also their most exciting contact with nature. What the four seasons of the year mean to the European, the one season of the monsoon means to the Indian. The summer monsoon is preceded by desolation; it brings with it the hopes of spring; it has the fullness of summer and the fulfillment of autumn all in one."

It was the monsoon that created the India Meteorological Department. The East India Company, which had a vested interest in getting its ships back and forth between England and India as quickly and safely as possible, built the first observatory in Asia at Madras in 1792, followed by others in Bombay, Calcutta, Simla, and Trivandrum, the last positioned on a hilltop overlooking the Arabian Sea so observers could watch the monsoon approaching. The monsoon was studied more rigorously, in greater detail and over a far greater scale than most of the weather over Europe. In 1886, India became the first country to begin issuing long range weather forecasts, following the discovery of the inverse relationship between heavy snowfall over the Himalayas in late May and the subsequent monsoon rainfall over Burma. At the time of Independence in 1947, India inherited the largest meteorological service in Asia.

And it was the experts of that meteorological service who would take me in and, drawing on science, lyrical prose and centuries of accumulated wisdom, would explain to me the secret inner workings of the monsoon.

From what I could tell, Western scientists hadn't written lyrical prose about weather for some 200 years, since what I began thinking of as the Golden Age of Weather.

The Golden Age of Weather ran from 1783 to 1848 (this dating owes a lot to Richard Hamblyn's fine book *The Invention of Clouds*), but it was preceded by a kind of one-man Silver Age, owned and operated by the inimitable and irrepressible Benjamin Franklin.

In 1743 Franklin, following up a hunch, gathered newspaper reports and travelers' letters and deduced that storms move up the East Coast of the U.S.—an astonishing feat of research in a day when there was virtually no such thing as an infrastructure of information. In 1752 he and his son flew the famous kite into the thunderstorm to demonstrate that lightning consisted of electricity, another inventive piece of research that could easily have killed him.

The Golden Age, though, began in 1783, a year described by the English naturalist Gilbert White as a year of "horrible phenomena," when "there was reason for the most enlightened person to be apprehensive."

In late spring, a strange and sulfurous fog settled over Europe and half of Asia. "[T]he Sun, at noon, looked as black as a Clouded moon," White wrote, "and shed a rust-colored ferruginous light upon the ground." The country people, he went on, looked "with a superstitious awe at its red, louring aspect.

"Horses and cattle grew restless and unnerved, shying at eddies of torpid air or at the thickening swarms of flies that had hatched in food that couldn't be kept fresh in the dispiritingly sultry air; meat rotted in cellars and...could only be eaten heavily spiced even on the day it was killed..." In mid-June, trees began to lose their leaves. Violent thunderstorms broke out, and at night weird displays of the Northern Lights flickered unusually far south. The old and the very young had difficulty breathing, others suffered headaches, nausea and depression. A black fever raged, according to the *Bath Chronicle*, "and carries off great numbers."

(It was Ben Franklin, by the way, who suggested in a paper to the Manchester Literary and Philosophical Society, that the effects might have a geological cause, as four of the world's most active volcanoes—two in Iceland, two in Japan—had recently erupted in sequence.)

The result of this eerie weather, Hamblyn argues, was that "[S]ome of the finest minds were beginning to pump serious thought into the atmosphere: Lamarck, Benjamin Franklin, Jean de Luc, and Pierre-Simon Laplace in France; Horace Benedict de Saussure in Switzerland; John Playfair and James Hutton in Scotland; Erasmus Darwin and John Dalton in England; and Richard Kirwin in Ireland. An entire generation of European and American researchers, whose primary scientific interests had hitherto been earthbound, renewed their attentions to the actions of the air."

What made this a Golden Age, though, was that it wasn't just scientists who were fascinated by the air. Fascination was not yet split: there was no distinction between the person and the subject, between material and spiritual, between study and awe.

The two most famous English painters of the time, John Constable and John Turner, were both as interested in weather as in landscape. Many of Turner's paintings consist of little but weather. John Constable, the English landscape painter, who called himself "the man of clouds," and said "The sky is the chief organ of sentiment," argued "Painting is a science and should be pursued as an inquiry into the laws of nature…Why, then, may not landscape painting be considered a branch of natural philosophy, of which pictures are but the experiments?"

John Ruskin, the great art critic, wrote *The Truth of Clouds, a covenant between mankind, the natural world and the divine*. Coleridge, Wordsworth, Shelley and Lamb were famously fascinated by weather. Coleridge attended Royal Institution lectures "to

renew my stock of metaphors" and described a landscape in which "mists, & Clouds, & Sunshine make endless combinations, as if heaven & Earth were forever talking to each other…"

The Romantics were perfectly aware that there was something divine in weather, yes, but there was also something divine *in the act of contemplating something so sublime*. For them, studying weather was anything but a question of trying to nail down answers; the activity in itself was ennobling and inspiring.

Conversely, scientists saw little distinction between themselves and artists. In 1802, Luke Howard invented classifications in Latin for clouds—the basis for the classifications still used today--but his description of the cumulus shows that he was as interested in the aesthetic essence of the cloud as he was of the physics: "Independently of the beauty and magnificence it adds to the face of nature, the cumulus serves to [screen] the earth from the direct rays of the sun, by its multiplied reflections to diffuse, and, as it were, economize the light, and also to convey the product of evaporation to a distance from the place of its origin."

In the same vein, when Howard's *On the Modifications of Clouds, &c.* was reviewed in the *Annual Review* in 1804 the reviewer wrote not only about its scientific importance, but how it would appeal to anyone who "has viewed the sublime spectacle of a moonlight evening" and has been struck by "how much the beauty of the scene has been occasionally heightened by the large round masses of cloud, which not infrequently sail across the firmament, and 'turn forth their sliver linings on the night.'"

And in case this sounds as if one reviewer simply got carried away and strayed from science into poetry, he was by no means alone: Goethe, who was not only one of the great poets and dramatists but also one of the great scientists of the age, wrote a series of poems on the mood, mechanics and classifications of clouds.

The most radical acknowledgment of weather's importance appeared in revolutionary France, where the calendar was reorganized (temporarily) into months based on weather and agriculture, such as Brumaire, the month of fog (October 22-November 20), Frimaire, the month of frost (November 21-December 20) and Pluviose, the month of rain (January 20-February 18).

Even if he didn't want to change the calendar, every politician knew the importance of weather. George Washington kept a weather diary. Jefferson made twice-daily weather observations for most of his adult life, even during the debate over the Declaration of Independence, keeping his Weather Memorandum Book from July 1776 until shortly before his death in 1826. It was America's clear, cheerful weather, he asserted, that "has eradicated from our constitutions all dispositions to hang ourselves, which we might otherwise have inherited from our English ancestors." He gave Lewis and Clark long, detailed instructions to take particular note of the climate of the West.

Shortly afterwards, in 1806, Francis Beaufort invented his wind scale in order to categorize wind in terms of its effect on a square-rigged ship. ("6: Moderate Breeze, or that which a well-conditioned man-of-war, with all sail set, and clean full, would go in smooth water, from 5 to 6 knots.")

The Golden Age ended when this fascination became organized and segregated—bureaucratic, in a word. It was inevitable, I suppose, because, as Ruskin wrote, "The meteorologist is impotent if alone." To watch only your own weather is to be regularly baffled, caught by surprise. To be able to watch the weather of a

continent, of the entire globe, is to be able to see its rhythm, predictable in its gross and scope, if not in the country-by-country, farm-by-farm details. In 1848 Joseph Henry, director of newly-established Smithsonian Institution, following Ruskin's dictum, recruited a group of volunteers to take weather observations four times a day using equipment developed and distributed by the Smithsonian. Henry's network would become the basis for the National Weather Service, and for forecasting as a collaborative endeavor. It was the beginning of the modern age of meteorology.

Henry's volunteers included teachers, ministers, doctors, college presidents, state representatives, even the president of the American Medical Association--educated amateurs, in the old French sense of people who loved their tasks. Yet their enthusiasms were already being harnessed in a way that must have struck some of them as demeaning: their job was to reduce the fantastic vagaries of weather to data. In 1801 Captain Hayman Rooke was so taken by rows of "small white clouds in radiated columns" that he sketched them, and that sketch was later engraved and published. Henry's crew had no such instructions: weather was now temperature, wind speed and air pressure, to be sent to Washington so somebody else could make sense of it.

The Golden Age of Weather fascinates me because weather was still an aspect of what the Romantics called the Sublime. It was capable of inspiring awe, even terror—but that was its value and its right.

Weather is ineffable. It's all about light, or the restrictions of light, light struggling to reach us, light bathing us, light without which no revelation is possible, light the opposite of blindness. Or it's about water, which is life made visible, life coalesced, the currency of life. Or wind, invisible, constant, the ambassador of change and time. Weather is greater than us, unpredictable, disrespectful, majestic, an expression of the peculiar properties of water, the turning of the planet and the brilliance of the sun.

His black tongue

A contact at the National Weather Service forwarded me a Reuters story saying that the pre-monsoon heat in the southern state of Andhra Pradesh had already killed 178 people, and the number was rising steeply. The temperature was 48 degrees Celsius along the coast—118 Fahrenheit. The state's relief commissioner was advising people to stay indoors between noon and 4 p.m., and those who ventured out should cover their heads with white cloths.

"But that's why I'm going," I told my editor, who was starting to sound nervous. "I'm off to see real weather. Don't worry. I'll be in meteorological offices in cities. Everywhere I'm going will be air- conditioned. Besides, I'm not going anywhere near Andhra Pradesh." I had no idea where Andhra Pradesh was. I'd never been to India. Never been east of Czechoslovakia. I know a lot of Indians from playing cricket, but even cricket in India would turn out to be far more Indian than I could have imagined.

Around the same time, a short announcement came on the news that India was expelling the Pakistani Ambassador in retaliation for suicide attacks by Kashmiri separatists on the Indian Parliament buildings in New Delhi that left nine Indians dead. Nearly a million Indian troops were being dispatched to the disputed state of Kashmir. Pakistan hinted at nuclear tests. A global anxiety was waking, a deep stirring in the swamps of the collective unconscious. A headline in the *Times of India* snarled that it would be suicide for Pakistan to use the nuclear option. But there the possibility was, launched into the global imagination, a contrail like a deformed cloud, announcing by its unnatural shape alone that something was wrong.

And speaking of the first signs that something might be wrong: India's best and brightest weathermen seemed not to know when this year's monsoon would actually be arriving. There was talk of promising early thunderstorms, but there was also a report that it had stalled over Sri Lanka. And then there was the rather odd tradition, almost a ritual, that the director-general of the India Meteorological Department made his annual monsoon forecast *once it had actually arrived*.

I began to pick up the sense that Indian meteorologists saw the monsoon as a vast and capricious animal--an elderly elephant, perhaps, on a divine scale, like a Hindu deity--who might come when she was called, but equally might not. Its epic uncertainty was already starting to affect my own life, halfway across the globe.

"So, when are you leaving?" asked my wife Barbara, her date book open, trying to sort out summer camp, child care, and her own work schedule.

"Well, I'm not really sure. The traditional date for the monsoon to make landfall in southern India, which is where I want to see it, is June 1st, but it could be as much as a week early or a week late. So I'll probably have to go out in the last week of May, but there's always a chance I'll have to hang around waiting for it."

She looked darkly at her appointment book. "All right. So when do you think you'll be coming back?"

"Well, again, I don't know. If the monsoon is early I could be back in the first week in June. But if it's late…."

She muttered and began drawing long lines across pages of her book.

While the *National Geographic* Travel Office was trying to buy tickets and book hotels for me despite the fact that I had no idea where I would need to be, or when (and in the process laying out more cash to send me to India than all the expenses budgets of all the articles I'd written for other magazines *combined*), the magazine's medical division was giving me typhoid.

Not the full-blown fever, of course, just the hint, the thumbnail version, brought on by taking live-culture vaccine. The medics sent me four pills, to be taken every other day. At once, a strange, disturbing clench in the bowels set in--no nausea, just a constant, strong message that something was very wrong. And at the same time, odd headaches that felt as if some tropical creature, a lizard, perhaps, or a horned toad, was underneath the cap of my skull, sitting athwart my brain, the weight of its broad body pressing steadily, and every so often a small, very pointed pain down at my temples as if it were tightening the grip in one claw.

Once the anti-typhoid treatment was under way, *National Geographic* sent me a care package of preemptive medicines the size of a high school student's backpack. Pills for making dubious water drinkable. Gatorade in case I needed rapid rehydration after dysentery. Tylenol-with-codeine, in case I had to drag myself back to civilization on a broken leg. Sunblock that vengefully leaked over everything else. Industrial-strength bug spray. An epinephrine syringe, in case of an anaphylactic attack. First aid kit. Antihistamines. Asthma inhaler. Letter from the doctor saying it was okay that I was carrying syringes and enough drugs to enable me to sell them on the street and take early retirement.

This was just the start of my traveler's healthcare plan. Next, I went over to the local hospital, where the Travel Medicine physician gave me shots, and then very, very strict instructions on all the fatal diseases waiting for me in India.

"The first time you get dengue, it's not usually too bad," she said. "It doesn't kill you, but the joint pain is so excruciating it feels as if all your bones are being broken at the same time." If I were bitten by a mosquito during daylight, I would get dengue fever, if I were bitten at night it would be by a different mosquito and I'd get malaria, and if in a rural area with paddy fields I'd get Japanese encephalitis. She didn't say what Japanese encephalitis does, but I found myself remembering a graduate student who caught encephalitis by some freak accident not involving travel to the tropics. He disappeared for nine months and when he turned up on campus again he slurred his words and walked very slowly with a cane.

She didn't have time to get all the vaccines in me that they'd like to, so I'd just have to use a great deal of insect repellent whenever I went outdoors.

Then there were the gastric diseases. "Everyone gets traveler's diarrhea," she said casually. The real danger was the wide menu of available water- and food-borne parasites. A friend suggested I read an essay by Paul Theroux called "Parasites I Have Known."

Jyoti Daniere, an Indian friend who took her American husband to India, told me with great amusement that he had made the mistake of eating the hotel buffet and

got so sick his tongue turned black. They rushed him to the hospital, where the doctor talked rehydration and antibiotics.

"But what about his tongue?" Jyoti wailed. "His tongue's *black*."

The doctor looked at her, unmoved. "I am not concerned with his black tongue," he said.

So: don't drink the water. Don't drink anything with ice in it, as the ice is made of water. Drink bottled water, but look carefully at the seal in case someone has refilled the bottle with tap water to sell it again. Don't drink milk or eat dairy products. Don't eat fruits or vegetables unless you have peeled them yourself. Avoid meats. All that left was beer.

A message from India

The India Meteorological Department turned out to be less a network of scientists and public servants and more of a high priesthood.

Their website was as opaque as a window painted gray. Its home page, in fact, featured a photo of a grayish modern building against a background of gray. The site would tell me the organizational hierarchy of the Department; it would tell me what appeared to be the Top Ten meteorologists, or possibly the order of succession to the throne, but it certainly wouldn't tell me where any of these offices were, who was in charge of them, their addresses, phone numbers or email addresses, or *anything at all about the monsoon*. An official monsoon forecast would be made on May 25, and before that date everything about the monsoon would be one of the eternal mysteries, the property of the elect.

If I wanted to contact the Office of the Director General (Weather Forecasting) at Pune, I'd have to sift through several dozen memos, oblique references, professional papers and the report of a visit by a British meteorologist in order to cull an email address (not in use), a fax number (out of service) and an address, to which I sent a letter by courier. The sub-office at Trivandrum was even harder to pin down; in the end I sent a similar letter addressed simply to the IMD at Trivandrum, reasoning that everyone knew the temple where the high priests worked—though in the great tradition of civil servants, it was always possible that the director of the local post office hated the director of the local meteorology office, and routinely dumped his mail into the Arabian Sea.

The only person who mattered, though, was the Director-General of the IMD, the high priest, Dr. R.R. Kelkar. For him I had an address, two phone numbers and no fewer than three email addresses. The problem, I was told by Indian meteorologists working in the United States, was that if for some reason he didn't want to help, he wouldn't reply on any of these channels. And if he didn't give my visit his blessing, nobody under him would talk to me, and I'd run into the same kind of reception I got in communist Prague in 1989, when I asked a question of a clerk in the state-run travel office and she didn't even look up. Just sat there, and went on eating her sandwich. Didn't even look up.

So I wrote to Kelkar as politely as I could, and waited. For several days, nothing. Then I got an email from the great man, which I opened with trembling fingers. He had read my message carefully, he said, and had several suggestions. First, a German magazine had written recently about the monsoon—an article entitled, "Monsun." Had I read it?

Puzzled, I read on. How many pages, he asked, was *National Geographic* planning to devote to the monsoon? Would there be photographs? The places to go would be Pune, Goa, Cochin and Trivandrum, but of course the meteorologists would be busy. He wished me well.

I was baffled. This was as opaque as the web page. Was it a yes or a no? It sounded more like a no—after all, the only thing he had said about his department was that everyone would be busy. I wrote back again, beseeching. No reply. Finally Dr.

Jagadish Shukla, formerly with MIT and NASA, now the head of the Center for Ocean-Land-Atmosphere Studies at George Mason University in Washington, and a man who knew Kelkar personally, told me, "No, that's a very encouraging letter! The fact that he replied at all is a very good sign! I would take it as a yes and just go there."

No sooner had he said this, though, when we saw the first sign of trouble on the horizon, a cloud no bigger than a man's hand. It was an email, from someone who was presumably an aide to Kelkar:

> Dear Mr. Brooks,
>
> This is in connection with your letter sent to Dr Kelkar regarding a film you wanted to make on monsoons. Kindly note that prior to any commencement of activity in India it would be appropriate to take a clearance from the Govt. Of India on the matter. I think your foreign office at Delhi may help you to get it expeditiously.
>
> On technical and scientific aspects IMD will be in position to help you further on your having procured the necessary permission.
>
> Please write to me in case you need to interact with IMD further. I shall consult DGM Dr Kelkar and keep you suitably informed.
>
> Kind regards
>
> B. Mukhopadhyay

A film? What was he talking about? I called *National Geographic*. Nobody could make sense of this message.

My editor and I both sent soothing messages explaining that I was not making a film, and I already had my journalist's visa from the Indian Embassy, so everything had been taken care of. Dot dot dot.

Later that summer, after I had returned from India, Dr. Shukla told me the story—confirmed at least in part from other sources—about the IMD's epic quest for a Cray supercomputer. When Rajiv Gandhi was prime minister, he was all too aware of the department's limitations, being a pilot and thus knowing the importance of good forecasting.

"He was probably a better meteorologist than some of the people working for the department!" Shukla chuckled.

In the early 1980s Rajiv met Ronald Reagan at the Plaza Hotel in New York and asked for a supercomputer. Reagan apparently had no idea what a supercomputer was or what it meant for meteorology, but he must have seen something in Gandhi that he liked, and instructed his staff that India was to be given a supercomputer.

At this, of course, half the Pentagon went into cardiac arrest, because a supercomputer could well be used to calculate missile telemetry, and India at the time was a client of the Soviets. (Some Indian hotel televisions still carry a channel in Russian: in Bombay I watched the World Cup game between France and Uruguay with Russian commentary.)

Nevertheless, Reagan insisted, and eventually India got its supercomputer. In more recent years, though, Shukla said, the machine had fallen upon hard times, not

least because of the clash between modern equipment and ancient bureaucracy. For six months the computer was down, he said, because the order requisitioning a replacement part was sitting in some official's in-tray.

My whole journey to India might have made more sense if I had heard this story before I left.

Flights from the United States to India, it turned out, routinely make layovers in Europe, so I emailed the European Centre for Medium-range Weather Forecasting (one of the best forecasting organizations in the world) outside London, hoping to set up some interviews when I returned, still dripping, from South Asia. Even this simple request had complications I hadn't anticipated.

My emails go out over one of those little mottoes, automatically appended to every message like an electronic bumper sticker, that reads: "If it were easy, someone else would already have done it."

The reply from England said nothing about interviews with top meteorologists. Instead, I was treated to a lesson on grammar:

> Tim:
> "If it were easy, someone else would already have done it."
> I find the subjunctive very difficult.
> *Fowler's Modern English Usage* 2nd edition page 597 says (in more than three pages on text on the subject!):
> "'Were' (sing.) is, then, a recognizable subjunctive, and applicable not to past facts, but to present or future non-facts; it is entirely out of place in an 'if'-clause concerned with past actualities and not answered by a 'were' or 'would be' in the apodosis.'
> Some examples he gives later suggest that your end-line should read:
> "If it was easy, someone else would already have done it."
> I would be grateful for a correction - or reference to another authority - if I misunderstand the subject!
> Regards
> Austin Woods

The English--there's no one else quite like them. Just as well, probably.

Meanwhile, the heat in India was rapidly rising. The death toll now stood at over 600 in Andhra Pradesh alone since the beginning of the month. Temperatures had reached 124 degrees. Birds were falling dead from the trees. "Heat waves always precede the monsoon rains," one meteorologist told the Associated Press, apparently trying to be reassuring. "They induce the monsoon to come in."

I'd never been anywhere nearly as hot. It was starting to look as if I'd better fortify myself for my trip in a way I hadn't thought of before: I needed a tan. Vermont was emerging from the long, cold winter into a cool, wet spring. At night, a steady drip off the eaves, the chirping of the small frogs called peepers, and a curious lack of mosquitoes. My skin was white and soft, or when I was tired, gray and wrinkled. I was as ready for the Indian sun as battered cod and sliced potatoes are for hot oil.

The girl at the tanning salon, who was a highly-burnished orange color, told me I could squeeze five sessions in before I left. She took me to a small room with what looked like a high-tech coffin lined with fluorescent tubes. I was either about to become a rotisserie chicken or I was about to be put into suspended animation, to wake up in 150 years' time in orbit around Alpha Centauri. Yet when the lights came on and the fan started up, the dry heat was oddly familiar: it was exactly like hitchhiking in Nevada.

As if to puncture this euphoria, Mukhopadhyay was back.

Dear Mr. Brookes,

This in reference to your earlier correspondences with Dr. Kelkar DGM and DDGM(WF) Pune regarding your project in India for filming on the Indian Monsoons.

I have sent you an earlier message from a separate address regarding the need for a Govt. Of India Clearance for undertaking any such exercise. I believe you may have taken up the matter with your Embassy in India to procure some permission from our Foreign office, because you made a brief mention that you were aware of undertaking the formalities in your earlier email to Dr. Kelkar.

Kindly let us know whether you have been able to procure such permission.

You may reply to me at this email address.

Kind regards.

B. Mukhopadhyay

Director Publication

IMD

Why did he keep going on about a film? I wrote back, reassuring him again that I wasn't making a film, so we had all the clearance and permission we needed from the Embassy.

As if I needed more discouragement, tension between India and Pakistan over the disputed territory of Kashmir had been rising vertically since India had accused Pakistan of aiding and abetting terrorism—the charge that Bush had used as grounds for invading Afghanistan—and moved an invasion force up to the border. The Indian Prime Minister, Atal Bihari Vajpayee, went to Kashmir to tell his troops, "Your goal should be victory. It's time to fight a decisive battle."

Across the border, President Musharraf of Pakistan replied that Pakistan was ready to "meet any contingency resolutely and with full force."

On Saturday morning, the day I was due to leave, Musharraf reported that his country had run a successful test of a medium-range nuclear missile, and was "ready for war."

Meanwhile, bad news from Austin Woods, my subjunctive friend at the European Centre for Medium-Range Weather Forecasting. I had asked whether I could stop in on my way back from India and interview some of their meteorologists to get a more global perspective on weather forecasting, but the week I had in mind, he said, was unfortunate: in typical English fashion, the place would be closed on Monday, Tuesday and Wednesday for the Queen's Jubilee, and as England were playing Argentina in the World Cup on Friday, well, everyone at ECMWF had decided to take the whole week off.

What the hell was going on? How could weather forecasters take the week off? What with the dereliction of duty by the ECMWF and the fact that the IMD apparently no idea when the monsoon would hit Trivandrum, not to mention the prospect of nuclear war, I started getting just a bit tense.

Then, out of the blue (where the weather comes from), I got a message from my friend Andy Tolley, an Australian I hadn't seen for two years, who used to play with my cricket team. He asked what was up, I chatted about cricket and told him I was about to head off to India, and he sent back the message that would be my salvation.

Hi Tim,

Hey, if you get to southern India be sure to stop in and visit an old friend of mine, Faith Pandian. Originally from New Zealand, Faith is now living in India having started an unusual tour company over there and is now married to an Indian chap. She runs "spiritual" personalized tours (I've been on one and they are fantastic), and also started a taxi company over there which I hear is doing remarkably well. She also helps run an orphanage for kids. All in all, she is a fascinating wonderful person to meet and can show you pieces of India you'd never get to see otherwise.

Seeya,
Andy

Nothing sounded more enticing than a personalized spiritual tour, but I had work to do. Still, it would be useful to know somebody in India who knew the territory. Faith was in Tiruchapalli, which the British used to call Trichinopoly and now everyone called Trichy. I looked it up. Almost between Trivandrum and Bangalore. Maybe I'd be able to drop in on Faith after all.

Four days before I left, I discovered that the best place from which to watch the approaching Indian monsoon is Scotland.

With everything riding on the monsoon, and no news coming out of India about its progress, I was starting to worry in earnest that I might already have missed it. The India papers had nothing. Emails to the I.M.D. produced nothing. In desperation, I asked the National Weather Service if I could, in effect, spy from one of their satellites, and they said sure.

They sent me the web URL of a satellite receiving station in Dundee, Scotland, where images from a geostationary satellite above the Indian Ocean arrive on solid ground. It was a fascinating picture in smoky grays, made up of vertical crosses—plus signs—for grid points, the hand-drawn outlines of the continents, and there over the oceans, the monsoon.

It was the classic view from space, with large weather systems shown by their clouds, like teased-out cotton seeds. The eastern arm of the monsoon was clinging to the coast of South-East Asia, from Burma to Indonesia, a vast ghostly sketch. The western arm—my arm—was a little less dense, and to my amazement it stretched all the way from the Horn of Africa to the southern tip of India. The advance shading, in fact, was already over southern India, in particular one dense, almost exactly circular white spot, probably over the mountains just inland from the western coast. What were they called? The Western Ghats.

It was the first time I began to grasp the monsoon--its immense size, its pulsing nature, unlike the dense concentric vicious purpose of a hurricane or cyclone. But what it would be like to stand on that white line that was the shore of southern Kerala and look out over the grey ocean as those cottonseed clouds approached, I couldn't begin to imagine.

World weather

My flight left Montreal late Saturday afternoon, May 25th, so to get there on time I needed to leave home shortly after noon. The previous evening I checked the State Department and British High Commission web sites. I wasn't afraid of what was happening in Kashmir, I was afraid of flying. Flying makes me very nervous--a major handicap for a travel writer. What I was dreading was that I'd fly halfway around the world, land in Bombay and they'd say, "Sorry, you can't enter the country," and I'd have to fly all the way back at a time when my bloodstream was still seething with stress hormones.

The official web sites didn't even mention Kashmir, either on Friday evening or when I checked again on Saturday morning. That was it. I was off to Montreal, where the airport TV monitors were carrying not CNN or the Weather Channel but the Stanley Cup, bless 'em, and on to Air Canada, where for the first time in my life, thanks to *National Geographic*, I flew business class.

This was a mixed blessing. I discovered that if you fly business class the turbulence is scarier because the dishes, being made of china rather than plastic, rattle more loudly.

"Pakistan launches second test missile," CNN reported at Frankfurt Airport on Sunday morning. I was slumped as low as I could get in a tiny seat in the Lufthansa Business Class lounge. Having never flown anything above coach before, I'd always wondered what these executive lounges were like, their crested doors inevitably closed and mysterious. In this case it was a combination of very German security ("Boarding pass, please"), a dull array of free pastries and a giant 12-screen rectangular array of TV monitors, nine of which were dedicated to exercise infomercials, an endless display of yellow sports bras in motion. At least they weren't showing the Weather Channel.

I couldn't sleep. To get the back of the seat to support the back of my neck, I had to slide my bum so far forward that it hung over the lip of the chair, and if I relaxed I'd slide to the floor like a dead eel. With several hours before the Bombay flight, it seemed like a good time to study the international culture of weather. That was the other thing that business class lounges offered: business newspapers. Those crested doors concealed the world's dullest prose.

As I suspected, Europeans were interested in weather, but not as fanatic as Americans. A Swedish newspaper had a forecast for Stockholm down almost to a neighborhood-by-neighborhood level, but the German newspapers hadn't yet caught the *USA Today* half-page, full-color weather mania. I couldn't find the weather anywhere in *Die Zeit*. In *Welt am Sonntag* it was there in the familiar back-page-of-section-one spot, but it was given only about 20% of the page, as opposed to a full third of the page in the Gannett papers and the blockbuster 70% of a page in the *New York Times*. The small map of *Europa Heute* was colorful but sketchy—a token effort. The German edition of the *Financial Times* predictably stuck to black and white, the

color scheme of the Stock Market, and like the Big Board it went for breadth rather than depth: global coverage, but essentially meaningless data.

Nobody offered any sense of the weather as an atmospheric organism. It was just like learning world geography at secondary school: no matter how much time Mr. Wheeler drummed into our reluctant heads the exports and imports of the major countries of Africa, we never had the slightest sense of them as places, of what copra and coir were, of Africans actually using them for something, or of the circulation of trade, as global and mysterious as the circulation of wind and weather.

Welt am Sonntag included something called "Biowetter." Bioweather. Hmm. Did this mean pollen count? Smog index? "Personen mit Bluthochdruck," it went on, referring to people with high blood pressure, "konnen Befindensbeeintrachtigungen verspuren…." What? My high school German was unaccountably light on the jargon of meteorology.

Outside, though, was real weather. The panoramic windows of the lounge offered constant, soothing entertainment, free of exercise equipment. Technically, it would be called broken cumulus humilis and cumulus mediocris—in other words, a brilliant day. The sun glanced off the small, cheerful fragments of cloud to the southwest, making their soft eruptions seem all the more dramatic; and the clouds returned the favor by making the clear sky above and between them seem all the deeper in its effortless and intangible blue.

The flight path to Mumbai showed what a *lingua franca* the wind is, and the weather that surfs on its invisible waves. We flew over country after country where, at ground level, we'd have been shot, or at least turned back at the border. Yugoslavia, the Black Sea, Turkey, the terrible inhospitable mountains of Asia Minor, Iraq, Iran, Afghanistan, Pakistan… Like giant steel thistledown, we breezed right over the no-go-zones, the quarantined areas.

While everyone in the U.S. and Western Europe was looking at events in Kashmir and thinking, "World War III," I was wondering what the meteorologists on both sides were up to.

The history of military meteorology is not well known, but it is a great illustration of the fact that meteorology is a science, yes, but also an expression of a culture, and the needs and beliefs of that culture.

A clear illustration: when the first network of weather observers was set up in the United States in 1848, under the direction of the Smithsonian Institution, it took as its mission to study the weather and solve "the problem of American storms." Scholarly and inquisitive--concerned for the public good, but not military-minded.

In 1870, however, the entire operation was removed from under the Smithsonian's studious umbrella and given to the Army, under the general umbrella, so to speak, of the Signal Service. There were at least three good reasons for the change. First, as early as 1814 Army surgeons had been ordered to keep weather journals so the surgeon general could study the epidemiological link between climate and disease. Second, armies have always needed to guess at the next day's weather in order to decide whether to plan an attack, what conditions might exist underfoot and how best to take advantage of them, and so on. Wind conditions affect the trajectory of shells,

and therefore the science of aiming artillery. (The issue became infinitely more focused and urgent during the First World War, of course, with the introduction of gas attacks.) Third, it was probably also a great deal easier to tuck the rapidly-growing cost of maintaining a national weather network into the military budget.

In cultural terms, though, this completely redefined the task. Instead of studying the weather as an aim in itself, according to David Laskin in his fine book *Braving the Elements*, the job description changed to the familiar one of threat response. "[T]he Signal Service focused on the more practical business of protecting life and property through timely storm warnings and reliable daily forecasts—or `probabilities' as they were called until the slightly more authoritative-sounding `indications' was adopted in 1876; the term `forecast' did not come into use until 1889."

It's a sign how closely that weather and warfare continued to be linked that the current head of the National Weather Service, General Jack Kelly, trained as a military meteorologist, and gained his stripes, so to speak, in Turkey, writing weather forecasts for NATO warplanes.

Before leaving for India I got a first-hand display of combat meteorology at Fort Benning, Georgia, where, on the mud and stringy grass beside the slow, brown swirls of the Chattahoochee River, two men in camouflage were assembling a weather station.

To be more accurate, Special Operations Sergeant B (the Air Force regards combat weatherman as "high-value targets," and won't allow their full names to be revealed) was on security, lying on his stomach with his finger on the trigger of his M-4, while Sergeant D, face smeared with brown and green camouflage makeup, was unpacking the satellite antenna from his rucksack and assembling it. The finished work was an automated remote satellite weather station on a tripod, barely three feet tall, suitable for setting up in what their commanding officer Lieutenant G dryly called "an austere environment"—in other words, in enemy territory.

"Most people," he went on, half grinning, "see a weatherman as a geek with a pocket protector sitting behind a desk looking at a scope."

Combat weathermen are different because a weather forecast is only as good as the current-conditions data that is fed into it. An army that plans to launch precision-guided missiles and intends to hit a command post instead of a nearby hospital needs very good data, taken as close to its targets as possible. Which means sending weathermen into extreme forward positions. Which means training what might be called extreme weathermen: the Special Operations combat weathermen, distinguished by their gray berets. (There are only a hundred or so Gray Berets; until recently, even most people in the armed forces didn't know they existed.)

G, B, D and J, currently stationed at Fort Benning, but daily expecting a summons to the borders of Iraq, were Gray Berets. They were trained as Rangers to jump out of the back of a C-130 with their weapons slung around their necks and their weather gear in 75-pound rucksacks slung under their bellies on 15-foot umbilical cords so the equipment bundle hit the ground before they did.

They had also undergone Pathfinder training, so they could pick a drop zone, lay out a landing field and do air traffic control for incoming planes and helicopters. During the Gulf War some units were so far forward that combat weathermen took Iraqi prisoners, and there were combat weathermen among the team that liberated the American Embassy in Kuwait. No pocket protectors here.

"We have to be much more accurate than our civilian counterparts," G said. The most important role of weather forecasting in the civilian world, he said by way of an example, is for airlines. (This is why most NOAA stations are at or near airports.) But even if the forecast is slightly off, a pilot still has all manner of electronic aids in the cockpit and on the ground to help him land safely.

"We're forecasting for an area that may be a dirt landing strip, and [the pilot] may be landing with *nothing."*

War may, in fact, be the arena of meteorology that involves the highest stakes. General Dwight Eisenhower went ahead with the D-Day landings because Group Captain J. M. Stagg, Chief Meteorological Officer at Supreme Headquarters Allied Expeditionary Force, promised him that an apparently endless storm would abate for no more than 24 hours, on June 6. Stagg's forecast changed the course of the war. Had he been wrong, his forecast might have had equally dramatic results in a different direction.

Tech Sergeant J, the team leader, flipped open a charcoal-gray reinforced suitcase and demonstrated the equipment, piece by piece, like a very serious Fuller Brush salesman. In one pouch was a barometer/altimeter. In another, a device that showed temperature, dewpoint and relative humidity. Laser binoculars gave a readout of range, and could be used to gauge visibility and cloud altitude. In the foam core of the case lay the main unit, complete with built-in computer and satellite uplink capability to send a steady stream of data back to command HQ.

This, though, was the expensive and heavy end of the spectrum of Special Operations weather gear. The remote unit being set up by D was smaller, and needed nobody to operate it. After all, any dedicated task takes a man's attention away for a few moments, and in battle any distraction may be significant.

Which was why all the Gray Berets also carry the Kestrel 4000, a gray gadget the size and shape of a cell phone. A portable weather station, it measures barometric pressure, altitude, temperature, humidity, wind speed, wind chill, dew point, heat index and several other variables. Hold it up, point its little turbine into the wind, and its screen tells you everything the command post needs to know.

Yet even the Kestrel 4000 isn't meteorology at its most survival-level basic. The combat weathermen are trained (and are trained to train others) to take observations even if every sophisticated technological aid is busted. Stand with your back to the wind, and the area of low pressure is on your left—in the northern hemisphere, at least. Look at the small pines to estimate the wind. "I'd say three to five knots," G drawled. Or pick up a handful of grass, hold it at head height, let go, measure how far away it hits the ground.

"What's the temperature?" I asked G.

He looked this way and that, feeling the air on his cheek, his close-shaven neck. "I'd say 43-45 degrees. Weather Channel was wrong."

Even more secret than the existence of the Gray Berets is the forecasting that was done before and during the Salt Lake City Winter Olympics in 2002, less than five months after the events of September 11. The National Center for Atmospheric Research (NCAR) was asked to create software that at any moment would be able to predict the drift plume of a cloud of anthrax spores released in the Salt Lake City valley--a disaster waiting to happen, given that the valley suffers from an almost constant inversion that traps the air over the city.

NCAR was also approached by the Army Proving Ground nearby at Dugway, Utah: the Army wanted a similar kind of forecasting software program that would tell them at once what would happen if a terrorist attack hit one of the Dugway bunkers, releasing all kinds of unpleasant chemicals into the wind. The Oak Ridge Laboratories have also asked for similar models to integrate them into their evacuation plans: if we are hit under these atmospheric conditions, and nuclear fallout is released, which roads should we use for the evacuation?

That's what I was wondering, on the plane to Bombay: has the I.M.D. been asked to calculate fallout plumes for nuclear strikes on Delhi? On Lahore? It was a question I seriously thought of asking, once I had taken care of all the less sensitive stuff I had to gather for the article.

Somewhere over Afghanistan, I think, I finally found an Indian paper, the *Hindustan Times*. Yet it was neither helpful nor encouraging. No mention of a monsoon forecast of any kind.

"Rain or thundershowers are likely to occur at many places in Andaman and Nicobar Islands, coastal Karnataka and Kerala, at a few places in Arunachal Pradesh, Assam and Meghalaya, Nagaland, Manipur, Mizoram, Tripura, West Bengal and Sikkim, Jharkhand and Lakshadweep and at isolated places in Orissa, Bihar, Tamil Nadu and south interior Karnataka. Mainly dry weather will prevail over the rest of the country. Heavy Rainfall Warning: Heavy rain is likely to occur at isolated places in Andaman and Nicobar Islands, coastal Karnataka and Kerala during the next 48 hours."

That was it? Easily the smallest weather section yet. And a list of eleven Indian cities with high temp, low temp and rain, though it didn't say whether these figures were reported or forecast. Most places had 0 rain; Bangalore had 7. Inches? Feet? Fathoms? The list didn't even include Mumbai; it seemed to have been cut off after Hyderabad to make space for an ad for Career Launcher Services.

Meanwhile, on the front page, a small box from Agence France-Presse in Washington said that the State Department put out travel advisories for both India and Pakistan on Friday, warning citizens to defer traveling to either country and advising those already there to leave. The U.S. women's field hockey team pulled out and flew home. Friday? There was nothing in the web site even on Saturday morning! Would the Indian immigration authorities even allow me in the country? I thought so--after all, travel advisories are only advisory--but I couldn't be sure.

One item on the plus side, though: an article under the headline "`Miracle man' offers to work wonders" made the first of many connections between the hostilities in Kashmir and the monsoon.

"He is a self-styled miracle-man-cum-faith healer who says his prayers work wonders.

"Haji Mohiuddin Khan claims he can ease the Indo-Pak standoff in 10 days, resolve the Kashmir issue in 40 days and end the Ayodhya dispute in three months. How will he do it? Well, with the power of prayer, says the man who claims that God gave him supernatural powers in 1995.

"Cross-border terrorism has claimed many lives. My powers can definitely bring an end to the problem," Mohiuddin Khan says.

Khan has written letters to the President and the Prime Minister, offering his services. He says his track record is impressive.

"`I have brought showers to famine-hit areas of Uttar Pradesh, Karnataka and Tamil Nadu,' says Khan, a farmer by profession.

"`I have full faith in my prayers. The Almighty listens to me and brings rain to the drought-hit areas within 10 days,' asserts the 47-year-old Jaunpur-born Khan, who offers namaz five times a day.

"`I have treated thousands suffering from chronic diseases and now wish to help many more.

"`I can bless 10,000 people in a day, even heart and AIDS patients,' he says.

"The miracle man's journey has not always been smooth. When he visited Kerala on a healing mission, he was imprisoned for `ruining' the business of doctors and chemists, who said he was a fraud.

"`I was in jail in Kannur district for a month. After an investigation gave me the clean chit, the court ordered my release,' says Khan, who holds a B. Com. degree from the Shilbi National College, Azamgarh."

Before settling into the comfortable assumption that belief in rainmakers is a sure sign of an ignorant and superstitious culture, it's worth bearing in mind that one of the most famous and apparently successful rainmakers of all time was an American, who died as recently as 1958.

His name was Charles M. Hatfield, and he called himself the Moisture Accelerator. He actually came late to his trade, because the heyday of rainmaking had been in the 1880s and 1890s, when such figures as Frank Melbourne, "the Australian Wizard," and G. B. Jewell, who operated from a specially equipped boxcar, were well known. Hatfield began experimenting with chemicals and "evaporating tanks" around 1902, and by 1904 the *Los Angeles Times* was writing "For the consideration of $50 Hadfield [sic] has planted his instruments in the foothill district near Pasadena and with a new process of chemical evaporation promises abundant moisture in five days. The magician holds himself responsible for the abundant rain in San Diego County late last spring, and says he has tried 17 times, scoring only one failure. Barnett & Gude, H. E. Memory, H. G. Ackley and others stand sponsor to this commander of nature."

His almost catastrophic triumph, though, took place in San Diego County in 1916. A delegation from the San Diego Wide Awake Improvement Club asked Hatfield if he could do anything about the fact that the Morena Reservoir, a principal source of fresh water for San Diego, was barely one-third full. Hatfield, according to the San Diego Historical Society, offered to provide rain free, then charge $1,000 per inch for anything between forty and fifty inches. All rain over fifty inches also would be free. The council, sounding very much like the Mayor and Corporation of the rat-plagued German town of Hamelin, offered a fee of $10,000, payable when the reservoir filled up.

"On January 10 it rained hard," continues the Historical Society's account. "Five days later it poured, and water kept falling for five more days. The downpour temporarily halted a Panama-California Exposition in Balboa Park. Officials scrubbed

opening day races at the new Agua Caliente Race Track in Tijuana. Dry river beds filled so fast that some smaller bridges disappeared….

"Rising waters marooned a Santa Fe train just north of the city and sea launches rescued the passengers. More bridges washed away. Homes flooded. Someone at city hall decided this was too much too soon and tried calling Hatfield but the telephone lines were down, according to *Lost Legends of the West*, written by Brad Williams and Choral Pepper.

"The saturated sod served as a skidway for the water. A dam at Lower Otay Lake `simply vanished under the pressure,' said Williams and Pepper. The Sweetwater Dam ruptured. Muddy waters covered farms and ranches. Homes slipped off their foundations; some ended up like flotsam."

Hatfield must have realized that he was in a tough spot: he had to claim that the rain was his doing, or he wouldn't get paid, but if he acknowledged responsibility for the rain, he could get sued. Hedging his bets, he said he shouldn't be held accountable for damage to life or property. "I entered into a contract with the city," he said evasively, "and it was up to the city to take the necessary precautions."

The city council, sounding even more Hamelinian, refused to pay Hatfield, claiming that (a) he could not prove that he had caused the rain, and (b) even if he could, then the city by paying him would itself be open to liability. Hatfield badgered the city council, then offered to settle for $4,000 and even filed a lawsuit for the money San Diego owed him. The city said it would pay his fee if he'd handle the lawsuits pending against the city for hiring him in the first place. The city ignored Hatfield until the suit expired in 1938. In the two liability suits that actually came to trial, the rain was ruled an Act of God.

Hatfield spent the latter part of his life in relative anonymity as a sewing-machine salesman, but what drove him out of the moisture acceleration business was not overriding scientific skepticism (nor perpetual litigation) but irrigation. When Boulder (now Hoover) Dam was finished in 1935, the intimate and at times desperate relationship between farmers and rain was changed forever. From then on, rain came by pipe. Rain was an issue not of Providence but of plumbing.

"You're going out in the first rain of the monsoon?" asked the Indian flight attendant, hunkering down in the aisle to give me and the monsoon her full attention. "Oh, I shouldn't do that if I were you. Mothers always tell their children not to go out in the first rains, or they'll come down with all kinds of chills and fevers. Some people think it's because the first rain brings down all the pollution, especially up in Bombay. Perhaps it's just the change of seasons, and running around getting wet and chilled after being so hot and parched. One way or another, though, it does seem to be true."

I asked her if it was true, as Frater had said, that the monsoon was a time for weddings. She looked surprised. "No, the time for weddings is in December and January," she said; she herself was getting married then. No, the other accompaniment to the monsoon was a change in diet. "All the old grannies start making pakoras and samosas," she said. Hot food for the cooler season, come round at last.

The newspaper, though, seemed to contradict her. I was about to tuck it into the seat pocket when the personals section fell out. I glanced at it, and instead of the

usual "Vegan couple into light bondage seek F/Bi submissive…" the front page was full of ads for brides.

Under headings that specified geography (Punjabi, Khatri, N.R.I. for Non Resident Indian), caste (Brahmin), religion (Sikh) or profession (Doctors, MBA/Professionals), the paper cried across the void for girls, preferably light-skinned girls.

"Alliance invited from good looking, very fair, smart, slim, min 5 feet 4 inch, educated, homely girl between 21-24 yrs from well cultured established family for Delhi based Commerce Post Graduate…boy 27 years 5 feet 10 inch, fair, smart, very handsome engaged in family business. Industrialist family of high status and high income…"

One said "No dowry," some said liberally "Caste no bar." A Sikh bank manager in Sydney drawing a salary in six figures wanted a recent photo and horoscope "with complete bio-data." One specified a convent education; many stressed teetotal or vegetarian qualities.

"Grooms Wanted," roughly an equal number of ads, began on page A3, and here the value of a convent education clearly paid off. Once again, the personality of bride and groom was rarely even raised, much more ink being given to slimness, fairness and "family engaged in plywood industries business." Under the circumstances, my hat was off to the "renowned business family of New Delhi" who recognized that, in their future son-in-law, "An excellent and immaculate sense of humour is an absolute imperative."

In the face of such wisdom, nuclear war seemed even more remote, and the plane flew on toward the vast celestial ripples of the approaching monsoon.