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BLOW, WINDS

Blow, winds, and crack your cheeks! Rage! Blow!
You cataracts and hurricanoes, spout
Till you have drench'd our steeples, drowned the cocks!

-- William Shakespeare, *King Lear*

In early March where I live, while old snow lingers in the woods and floe ice is stacked along the Lake Michigan shore, there comes a day when the wind shifts to the south and brings the fragrant, promising odors of new growth and freshly turned soil. The wind, though not yet warm, smells as if it will soon be warm. More cold and snow may be likely in a few days or a week, but that southerly breeze is the turning point of winter. It has brought the change of seasons as surely as it will bring, in a few more weeks, Canada geese and gentle rain.

As long as humans have stood on hilltops and felt the force of moving air they have wondered about its origin. In early civilizations the wind was the breath of the gods, blown gently in pleasure or tempestuously in rage. In Greek mythology it was controlled by vengeful Poseidon, the god of the seas, and by Aeolus who kept it locked for safekeeping in an enormous, whistling cavern. When Aeolus played his harp men heard the music of the breeze in the trees; when he blew his conch shell great storms devastated the land and turned the ocean deadly. The four winds -- Boreas, Zephyr, Notus, and Argestes -- were the children of Eos, goddess of the dawn. Another goddess,

Eurynome, was said to have stirred the north wind into existence by dancing, then to have mated with it and given birth to the world. According to Homer, Aeolus presented the winds tied up in a leather bag to Odysseus to aid him in his travels, but when Odysseus's companions opened the bag the winds escaped and whirled away to cause mischief around the world.

The Greek astronomer Anaximander was among the first in the western world to contend that the wind was not a supernatural force wielded by the gods, but a natural "flowing of air" that could be examined and studied. A century later, the philosopher Anaxagoras theorized that heat caused air to rise, and that it cooled as it ascended, eventually forming clouds. Aristotle argued that the winds were dry exhalations of the sun, as opposed to the wet exhalations that caused rain. The first-century Roman naturalist Pliny the Elder, offered the opinion in his *Natural History* that steady winds might fall from the stars, or result from "the continuous motion of the world and the impact of the stars traveling in the opposite direction," or come as a "breath that generates the universe by fluctuating to and fro as in a sort of womb." Gusts of wind, to Pliny, had a terrestrial origin, formed "when bodies of water breathe out a vapor that is neither condensed into mist or solidified into clouds," or were simply "the dry and parched breath from the earth."

The wind is a complex collection of forces with a simple origin: the sun. Where the sun shines longest and most directly on earth, the ground is warmed, air rises above it, and cooler air flows in to take its place. It is that flowing transfer of air from cool regions to warm that we feel as wind. In spring the slowly elevating sun moves northward, heating the land and displacing the cold that had settled in during the winter. As the sun rises higher in the sky each day, newly heated air rises, creating a steep

barometric gradient from north to south, allowing cold air from the north to rush in to replace the rising warm air. That air is in turn warmed, rises, and is replaced by yet more cold air.

Those same winds play an important role in melting the winter's accumulation of snow. The common belief that spring rains cause snow to disappear quickly is not true. Rain by itself, though it may make snow settle, actually melts very little snow unless it is accompanied by a warm wind. Even the sun is a slow melter of anything but dirty snow. Dirty snow absorbs a great deal of heat, every fleck of dirt and bark acting like a solar conductor into the snowpack. But it is wind that melts snow best. Warm, moist winds create condensation on the snow's surface, which in turn gives off heat and raises the temperature of the wind even more, sometimes resulting in such rapid melting that the saturated soil cannot absorb it fast enough to avoid flooding. When the winds are warm and dry, like the Chinook winds of the Rocky Mountains, they can melt huge amounts of snow almost overnight, yet cause no flooding because much of the snow sublimates directly into the dry air without melting into water first.

In a less complicated world, warm air at the equator would rise, allowing cold air at the poles to flow to the equator, and all winds would blow strictly from the north or the south. Complications abound however, because air heats more quickly over land than water, as well as over certain types of land, such as asphalt parking lots, golf courses, and deserts. Uneven heating of the surface creates wind because air is ceaseless in its efforts to reach an equilibrium of temperature.

The most significant influence on global winds is the rotation of the earth itself. When the earth spins on its axis, a point of land on the equator travels at about 1,000 miles per hour to complete a revolution in twenty-four

hours. But as you move toward the poles, points on the surface of the planet make progressively smaller revolutions and travel more slowly to make that same twenty-four-hour circuit. This principle, named the Coriolis effect for the French physicist who identified it in the early nineteenth century, can be demonstrated on a spinning phonograph record. The center turns at a leisurely rate to make thirty-three revolutions in one minute, while a spot on the outer rim must speed rapidly to make the same number of revolutions in the same amount of time.

Because of the Coriolis effect, when air currents travel north from the equator the ground gradually slows beneath them, causing the winds to curve to the east. Likewise, air currents traveling south toward the equator find themselves passing over ground that is continually speeding up, causing the air currents to curve toward the west. Thus storm systems in the Northern Hemisphere usually rotate counterclockwise and storm systems in the Southern Hemisphere usually rotate in a clockwise direction.

Upper atmospheric winds are predominantly westerly over much of the earth, while surface winds vary considerably from place to place. *Anabatic*, or upslope winds, are common in valleys, where air warming through the daylight hours expands and is driven uphill. After sunset, the air cools and reverses its direction, rushing back down the valley to become *katabatic*, or downslope winds.

Wind, like water descending a riverbed, is subject to friction. Hills, trees, and buildings cause land winds to be less than half the strength of corresponding winds over water. In the same way that stones in a river create surface waves, obstructions on land break the wind into gusts. Gusts are less common at sea, although they can be caused by swelling waves. At

heights above about 2,000 feet, the effects of surface friction can no longer be felt, and the wind blows steadily.

Anyone who has spent much time near the shore of and ocean or large lake is likely to have noticed that wind directions over the water change dramatically every day. When the weather is warm, sunlight during the day heats the land to a higher temperature than the water. As the heated air over the land rises, the cooler air above the water blows in to take its place. Daytime breezes increase as the day progresses and the land temperatures increase, reaching a peak in late afternoon. At night the situation is reversed. The water retains much of the heat it absorbed in the day, while the land quickly cools. The rising warm air over the water creates a pressure gradient that pulls cooler air toward it, and the cool land air blows out to sea. Thus, coastal breezes at night are typically offshore, blowing from the land to the water, while during the day they are usually onshore, blowing from the water to the land. Near sunset and sunrise equal temperatures on land and water will often cause a temporary period of calm. Mariners in the days of square-rigged sailing vessels remembered these tendencies of the wind by saying, "In by day, out by night."

Wherever powerful and unusual winds occur they earn names for themselves. The *blue norther* of Texas is a winter wind that precedes a fast-moving cold front, replacing warm, moist air with a furious, bone-chilling northerly wind that can drop temperatures as much as 50 degrees in two or three hours.

Chinook winds, named for the Chinook Indians of the western slopes of the northern Rockies, are warm, strong, westerly winds appearing out of clear skies several times each winter in the eastern foothills of the Rockies from Colorado to Alberta, Canada. They often raise the temperature

overnight by as much as 40 or 50 degrees. By the time Chinook winds reach the high plains, they have lost so much moisture in their passage over the Rockies that humidity is only about 40 percent or less. That dry, relatively warm air can evaporate snow at the rate of an inch per hour -- a phenomenon that caused the Blackfoot Indians to call the wind "snow eater." One of the most dramatic of recorded Chinook winds swept down from the Black Hills to Rapid City, South Dakota on January 22, 1943, and in the span of two minutes raised the temperature from
-10 to +45 degrees Fahrenheit.

A *derecho* is a rare, powerful, fast-moving wind that sweeps across land 240 or more miles ahead of a major storm front or a band of thunderstorms. With winds of nearly 60 miles per hour lasting for 30 minutes or longer, it can cause what meteorologists call “straight-line wind damage” to differentiate from the damage caused by tornadoes and hurricanes. The name comes from the Spanish word for “straight” or “direct.”

The *foehn* of the Alps is another snow eater, deriving its name from the Latin *favonius* for "south wind," or from the Gothic *fon* for "fire." A sudden hot, dry wind that sweeps down on valleys in the Alps, the foehn causes such sudden thaws that the snow often avalanches. As with the Chinook winds of North America, temperatures can rise rapidly fifty or more degrees, and the air is so hot and dry that snow is sublimated directly to water vapor. Foehn winds also desiccate the moisture from wood structures, creating fire hazards. The winds are caused by a low-pressure front from the northwest that cools and condenses as it rises over the mountains. On the opposite side of the summit the air that is drawn down warms about one degree Fahrenheit for every 176 feet of descent. By the time the air reaches the valley bottoms it is hot and extremely dry.

Monsoon winds, from the Arabic word *mausim* ("season"), are powerful winds that behave seasonally the way lesser coastal winds act daily. During the hot summer season in Southeast Asia, Arabia, and Australia, the heated land airs rise, sucking cooler ocean airs inland for months at a time. The winds, saturated with moisture from their passage over water, bring torrential rains with them. In winter, the winds reverse direction and the rains cease.

The *mistral*, or "master wind," is a sudden, harsh north wind that brings cold weather and winds of as much as ninety miles per hour down the Rhone Valley into southern France and the Mediterranean coast.

For at least forty days each year a katabatic wind known as the *bora* howls through the valleys of the Alps to the north coast of Adriatic Sea. The French novelist Stendhal complained that Trieste, in 1831, was battered by high winds five days a week and the *bora* the other two days. "I call it a high wind," he wrote, "when I hold on to my hat, and a *bora* when I am in danger of breaking my arm."

The *zonda* is a hot, dry summer wind that sweeps down the slopes of the Andes and across the pampas in Argentina, while the *tourments* are "tormenting" blizzard winds that strike the same mountains in winter.

Elsewhere in the world are the *buran*, a powerful Russian wind that brings blizzards in winter and thunderstorms in summer; the *datoo*, the east wind of Gibraltar; the refreshing *etesian* summer breeze of Greece; *frisk vind*, the gale-strength wind of Sweden; the *williwaw*, a squall that funnels seaward through valleys in the mountains near the Strait of Magellan; and the "gyrating" land and sea winds of South America, the *vrazones*.

Naturally, the wind can be a fearsome thing. Ethiopian tribesmen believed evil spirits dwelt in whirlwinds and would chase them away with

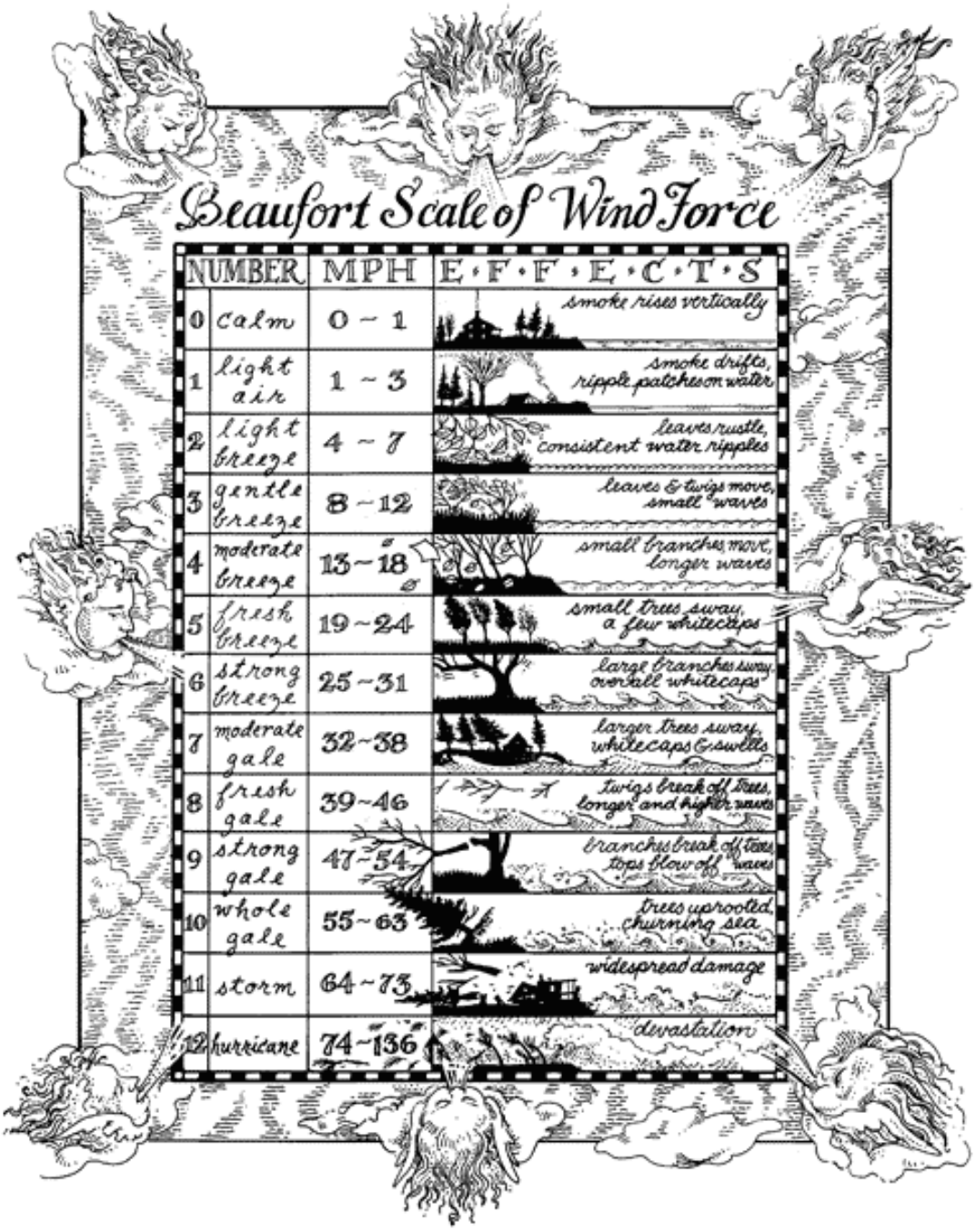
knives. Inuit women of the nineteenth century brandished clubs to chase the wind from their houses. The Greek historian Herodotus described Tunisians who marched into the desert with drums and cymbals to beat back a wind that had dried up their water supplies, and who perished when the wind returned and buried them in sand.

"Ill winds" were mentioned by Voltaire, who noticed a "black melancholy over the whole nation" whenever an east wind swept over France. George Eliot wrote that "Certain winds will make men's temper bad." Hippocrates, the father of modern medicine, suspected the west wind caused people to turn pale and sickly. Some modern researchers are exploring the possibility that winds can cause psychological and physiological reactions in people and animals. If periods of hot, dry winds cause you to feel restless and irritable, it might be because such winds create an imbalance in the ionic content of the atmosphere. Ions are atoms and molecules that have lost or gained an electrical charge, a condition that can be caused in nature by forces such as solar radiation, falling water, and strong winds. Researchers have studied their effects on humans and have found evidence that in some people an excess of positive ions inhibits the production of serotonin, one of the neurotransmitter substances of the brain, which causes feelings of lethargy, irritability, anxiety, or depression. Conversely, the same studies have suggested that for people who are sensitive to them, negative ions, such as those created by falling water, increase serotonin production and produce feelings of well-being or tranquility.

Few ill winds can compare in harshness to those that sweep across the deserts of the world. In Israel, the Sudan, Turkestan, the American Southwest, and other arid regions, powerful winds are usually bad news, and the source of a great deal of discomfort and danger. People of those regions

treat the vast, searing-hot winds and dust-storms with respect and fear, taking cover before them, even if the only way to find cover is to lay on the ground with turbans and robes pulled over their heads to avoid breathing the hot blowing sand and dust. Depending on where in the world you go, you might have the misfortune of running into the *sharav* of Israel, which has been accused of giving more than 25 percent of the population respiratory difficulties, headaches, nausea, and irritability; the *sirocco*, an oppressively hot, dry, dust-laden southerly wind that blows from the North African desert to Italy and the rest of the Mediterranean region, most often in spring; the *tebbad*, or "fever wind" of Turkestan; the *simoom*, or "poison wind" that blows from Libya to Saudi Arabia and contributes much of the dust found in the atmosphere above Europe; the *harmattan* of Algeria and Morocco, a northeastern trade wind of the western Sahara; the *khamsin* of Egypt; the *Santa Ana* of southern California; and the *haboob* dust-storms of the Sudan and the American Southwest, whose leading edges of swirling dust can tower nearly a mile high and appear as impenetrable as solid walls.

How windy can it get? North America's Great Plains, with their hundreds of miles of flat or undulating terrain unbroken by trees or large hills, are swept by winds that average ten to twelve miles per hour, day after day, year-round, and frequently reach gale
force or higher during winter blizzards and summer thunderstorms. Early settlers, living in sod houses in the vast expanses of the plains, joked about including a "crowbar hole" in the sides of their houses through which they could test the weather without stepping outside. If they poked a crowbar through the hole and it bent in the wind, the weather was normal. If the crowbar broke off, it was a day better spent indoors.



Devised in 1805 by Sir Francis Beaufort of the British Royal Navy, the Beaufort Scale is still the standard system of wind measurement for mariners and pilots.