

**The New York Times**

January 25, 2013

# January Is the Cruellest Month

By NEIL SHUBIN

BY late January many of us residing in northern latitudes aren't sleeping well, overeat and are looking forward to the long sunlit days of July. Some people even get clinically depressed: a recent study revealed that some 10 percent of New Hampshire residents suffer from seasonal affective disorder. For too many people, this might seem like just a quirk of their personalities, or worse, a shortcoming. But the cause for our malaise lies in the working of our genes, organs — and, ultimately, in the chemical structure of moon rocks, like the ones returned by the Apollo space program.

Our perception of time defines the ways we interact with the planet and with one another. Humanity's increasing need to communicate and trade has led to an ever-finer parsing of the moments of our lives with each passing year. Our need to segment a day into milliseconds — as with high-frequency stock trades — would probably have shocked our ancestors as much as a jet plane landing in the ancient African savanna.

But some clocks have not changed with technology, human interchange or commerce. Virtually every part of us — all our organs, tissues and cells — are set to a rhythm of day and night. Kidneys slow down at night. That's a wonderful trait if you want to minimize trips outside of bed. The human liver works slowest in the morning hours, meaning the cheapest dates would be at breakfast.

How do these biological rhythms come about? We carry more than two trillion clocks inside of us. Our cellular clocks reside in the molecular machinery of DNA, which makes proteins that interact with one another and with DNA itself. Some combinations of these biological factors form a kind of molecular pendulum that swings back and forth between high and low levels of protein and gene activity, tuned to a virtual 24-hour day.

Our genetic clocks are set to the sun by our brains and our eyes. Light entering our eyes triggers a signal that ends in a tiny patch of cells in the brain. This brain region then emits hormones that coordinate the clocks in the different cells of the body. Mess with this system and things go awry really fast.

Jet lag, sleeping disorders and mood changes are just the tip of the iceberg: our

susceptibility to different cancers may be an outcome of having DNA clocks. Workers on graveyard shifts, exposed to artificial light during the night, have a greater propensity for a range of diseases. In addition, a recent study revealed that exposure to sunlight late in the day has a greater potential to cause skin cancers.

The reason is found inside the clocks: the error-checking apparatus for DNA inside skin cells operates most slowly in the early evening. As errors in our DNA accumulate, so do the mutations that can produce cancer.

Daily cycles are one of the most fundamental properties of life on earth. Examples abound, even in some of the disorders we suffer. In cases of advanced sleep phase syndrome, individuals typically fall asleep in the early evening, only to rise very early in the morning. People with A.S.P.S. have a very hard time changing this behavior, because the syndrome derives from a genetic mutation that causes a biochemical change to a part of their cellular clocks.

A version of this syndrome is seen in other animals: some mutant hamsters, even fruit flies, have rest and activity cycles that are shifted significantly earlier than normal. Genetic analysis of each of these mutants reveals the stunning fact that similar genetic and biochemical mechanisms are associated with the clock disorder in each species. Indeed, the more we look, the more we find clocks in living things as different as algae and people.

Our clocks tie us not only to other creatures, but also to the formation of the solar system itself. The spinning of the earth and rotation of the moon form a backbeat that thumps inside the chemistry of our cells. The Apollo missions returned [more than 840 pounds](#) of moon rock and soil samples. Analysis of minerals inside reveals that they have a chemical signature similar to those of Earth's crust and are in this respect unique among other bodies of the solar system.

The current theory that accounts for all the evidence is that a Mars-size asteroid hit the Earth over four billion years ago. The mélange of Earth's crust and asteroid debris ejected into space, ultimately congealing as the moon and tilting the primordial Earth.

With that great cataclysm came our seasons, months and the duration of days. Our internal timepieces, and some of the maladies we suffer, lie as artifacts of this moment in our planet's history.

Carl Sagan famously revealed in the fact that "we are stardust," because the elements that compose us are derived from the birth of stars and the explosion of supernovae. These

events are only the beginning of our deep connections to the universe. Written inside of us is the birth of the solar system and workings of the planet itself.

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