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SCIENCE

Living With a Star

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OUT THERE

It is a fact rarely appreciated by the general public that to professional astronomers, the Sun is a pretty boring star. Which in fact is great news for the rest of us.

It doesn't oscillate or explode, periodically scorching us or freezing us out. In all of recorded history, as far as scientists have been able to tell, the sun's output has varied by only a tenth of a percent.

But it is still a star that we live with, and stars can be temperamental — ask any Hollywood agent.

Our star is an enormous thermonuclear furnace more than a million times as big as Earth. At its center, where the temperature is 15 million degrees, 600 million tons of hydrogen are fused into 596 million tons of helium every second.

The missing four million tons are transformed into energy. They become sunshine; they are the mortgage payment for life on Earth.

Even a slight change in this precariously controlled violence can have drastic consequences on Earth. And so astronomers have been keeping careful watch on the sun in recent years as the number of sunspots blotting its surface approached an 11-year peak in 2014, ushering in what is often a season of dangerous storms on the sun.

Glimpsed in the light of glowing hydrogen, the solar surface seethes and bubbles like boiling oatmeal. Guided by intense magnetic fields, jets of gas rise and fall like rain along arcs that can reach far into the corona, a thin haze of million-degree electrified gas visible during solar eclipses.

So-called sunspots, which look dark only compared with the brilliance of the disk around them, occur in some regions where intense magnetic fields choke off the rising energy. They wax and wane in concert with the sun's magnetic field, which reverses its direction every 11 years.

Every sunspot cycle is slightly different and unpredictable. For the last half of the 17th century and partway into the next, sunspots nearly disappeared from the sun. That period corresponded to a prolonged era of European winters known as the Little Ice Age, and some astronomers have suggested there is a connection between low magnetic and sunspot activity and cooler temperatures on Earth.

Along with high sunspot numbers comes a greater frequency of storms known as solar flares that can rattle the entire solar system.

Recent observations with NASA's Solar Dynamics Observatory have detailed how magnetic lines of force can snap like overstretched rubber bands, releasing as much energy as 160 billion hydrogen bombs on the sun's surface.

These explosions can launch monstrous globs of high-energy particles and radiation into space. Radiation from these storms is one of the major health threats that astronauts could face on the long voyage to Mars.

When such a glob of gas hits our planet, Earth's magnetosphere cushions the blow. High-energy particles are funneled to the magnetic poles, where they create the dazzling displays known as the Northern or Southern Lights. But they can also wreak electrical havoc, causing blackouts and blinding satellites crucial to modern life and the national defense.

A solar flare in 1859 produced auroral lights as far south as Hawaii and set telegraphs sparking.

Sunspots recently peaked again in 2014 and are still dangerously high. So far the planet has escaped any direct hits this time around, but scientists are keeping a

weather eye on the good old sun.

Living with a star is exciting, but it requires eternal vigilance for the inevitable outbursts.

Correction: February 4, 2015

An earlier version of this article misstated the size of the sun compared with Earth. The sun is more than a million times as big as Earth, not millions of times as big. It also misstated the timeframe on which the sun's magnetic field reverses. It reverses direction every 11 years, not 22.

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