Powerful Solar Storm Happened Once, See What Caused It

https://www.youtube.com/watch?v=T_TQ8DRw8j8
transcript: https://dontveter.com/ec/carrington.pdf

It was September 2nd 1859.

People all over Europe and North America woke up at night, confused and still tired.

They were sure it was already morning, it was so bright outside.

But when they looked out of their windows they discovered it wasn't sunlight.

The skies were lit by countless intense auroras, red, green and purple.

They were so brilliant one could read a book as easily as in the afternoon.

Auroras appeared even in the regions where they had never been witnessed before, like Cuba, the Bahamas, Jamaica and Hawaii.

Cool visual effects weren't the only thing that both mesmerized and horrified people.

The most high-tech stuff at that time, telegraph wires, shorted out throughout Europe and the US.

Sparks were flying from equipment and many human operators got electric shocks.

Papers and telegraph offices burst into flames.

All the machines were immediately disconnected from their batteries and still they mysteriously kept sending broken messages.

Fires ignited by short circuits spread over large areas.

Colorful lights kept dancing overhead.

All this caused panic and total confusion.

Earth's inhabitants had never seen or experienced anything like that before.

At that time, very few people knew that the sun was to blame for the chaos.

One of them was English astronomer, Richard Carrington.

At about 11 AM on September 1st, the man was standing by a telescope in his private observatory.

He was watching sunspots on the surface of the sun.

Suddenly, two patches of intense white light broke out.

They looked as bright as direct sunlight at that moment.

The astronomer didn't know what a terrible commotion these flares would cause.

Later it became clear that the sun had produced an epic geomagnetic storm and unleashed it at our planet's protective layer.

Wave after wave of charged particles slammed into earth's atmosphere.

The planet's magnetic field wasn't powerful enough to stop them, it gave way and the storm hit Earth causing havoc.

The phenomenon got the name, the Carrington Event.

So far it's been the worst solar storm ever recorded.

Good thing it happened when people didn't have advanced technologies and weren't that vulnerable to the sun's geomagnetic fury.

The 1859 solar storm was three times more powerful than the one that happened on March 13th 1989.

Three days before it began, astronomers watched a massive eruption on the sun's surface.

Within a couple of minutes, a billion ton cloud of gas was hurled away from the star.

It rushed straight toward our planet at a speed of millions of miles per hour.

On Monday the 12th, the huge mass of solar plasma reached Earth's magnetic field.

This storm was so fierce it lit spectacular auroras and created underground electric currents beneath North America.

These currents must have found some weaknesses in the power grid of Quebec, Canada.

In less than three minutes the entire city lost power.

Millions of people found themselves in pitch black streets, dark buildings and stuck elevators.

They woke up in freezing cold homes, unable to cook breakfast.

The following 12-hour blackout closed businesses, airports and schools.

The Montreal metro was also shut.

In the US, hundreds of power grids started to have problems minutes after the storm hit Earth's surface.

Luckily, none of these issues led to a blackout.

The storm was severe enough to disrupt satellite communication systems and radio signals.

Some space satellites tumbled out of control for a few hours.

Lots of them had mysterious problems that went away as soon as the storm began to subside.

No newspaper mentioned it, but in 2012 Earth had a close shave after narrowly missing an extreme solar storm, the most intense in the past 150 years.

On July 23rd astronomers at space weather prediction center in Colorado spotted two clouds of energetic particles.

They erupted from the sun's surface and barreled into space.

Just 19 hours later, these clouds zoomed past the spot our planet had just left.

If the solar eruption had happened several days earlier, Earth would have ended up in the line of fire.

So what if a solar storm as powerful as the iconic Carrington Event happened nowadays?

How much more harm would it cause?

Would our life get back on track after such a disaster?

Before you learn the answers to these questions, let's figure out (find out) what a solar storm is.

The sun is a gigantic, constantly changing ball of molten gases. (molten gases?)

Every once in a while it spews out bursts of energy from solar flares.

Solar flares often go hand in hand with something called coronal mass ejections, those are giant bubbles of ionized gas that can speed up to more than 600 miles per second.

The most powerful volcanic eruptions pale in comparison with solar flares that release 10 million times more energy within a few minutes.

One solar flare can give out billions of tons of charged particles.

Solar flares are also insanely hot with the temperatures reaching several million degrees Fahrenheit.

Astronomers believe that such bursts of solar radiation happen when the sun's magnetic field gets twisted in some regions.

At one moment, all the pent-up energy is released.

The star sends out light and particles, mostly electrons and protons.

Most solar flares last for minutes, but some continue for hours.

Scientists classify solar flares depending on how brightly they shine in x-rays.

You aren't likely to notice the tiniest flares if you don't have special equipment.

Medium solar flares lead to fleeting radio blackouts at the poles, but nothing too serious.

It's x-class flares people should worry about.

They cause the strongest and longest lasting solar storms.

When people think about danger coming from space most of them imagine an approaching asteroid like the one that wiped out the dinosaurs, but apparently we should be much more worried about our good old sun.

A super strong solar storm heading toward earth won't happen at once.

First, there will be high energy sunlight, mostly ultraviolet rays and x-rays.

They will ionize our planet's upper atmosphere and mess up radio communication.

After that, a radiation storm will hit earth and finally, several days later, a colossal cloud of charged solar particles will reach our atmosphere.

The particles will interact with the planet's magnetic field and wreak havoc all over the world.

If an intense solar storm happened these days, it would start by disrupting GPS and knocking out satellites.

If any astronauts were space walking at that moment, they would have a mere minutes after the first flash of light to find shelter.

Their spacecraft would likely be properly shielded and safe enough.

The main challenge would be to get inside in time.

After that, the storm will proceed to interfere with satellite communications.

That's why tons of your daily activities, from calling your friends to paying with your credit card, would be at risk.

But one of the worst consequences would be connected with power grids.

Power surges caused by the particles coming from the sun would damage giant transformers.

Those take ages to replace especially if hundreds or even thousands get wrecked.

In some places, a failure of one power grid would make others collapse as well, creating a domino-like reaction.

Picture living without electricity for a day, a month, a year.

No light, no computers, no phones, water supply systems out of order, no food in supermarkets, plus without electricity it would be next to impossible to reboot the already failed power grids.

A powerful solar storm would cost people one trillion to two trillion dollars and that's just during the first year after it happens.

It would take the world another 4 to 10 years to recover.

The damage to all kinds of satellites alone would reach 70 billion.

Under majestic auroras, people would have to get used to a new, dramatically different lifestyle.

No doubt we'd have some kind of warning.

Modern equipment all over the world and in space doesn't stop watching the sun even for a second.

Once a bad solar storm happens, people would have some time to prepare, between several hours and a couple of days, and if transformers are taken offline in time, the consequences won't be so dramatic.

Now the following news might sound scary.

There are also super flares.

In comparison to them, our sun's burst of radiation are small potatoes.

Super flares mostly occur in young and active stars.

In 2016, astronomers saw such a phenomenon.

A star 1500 light years away from Earth produced a flare that was 10 billion times more powerful than any of those that burst from our sun.

It doesn't mean we're safe here on earth.

Even our middle-aged sun knows how to produce super flares, but while young stars can have them once a week or even more often.

For the sun, it's once in a few thousand years and still if people don't figure out how to protect the planet, just one super flare can shred our ozone layer and wipe out life on earth.