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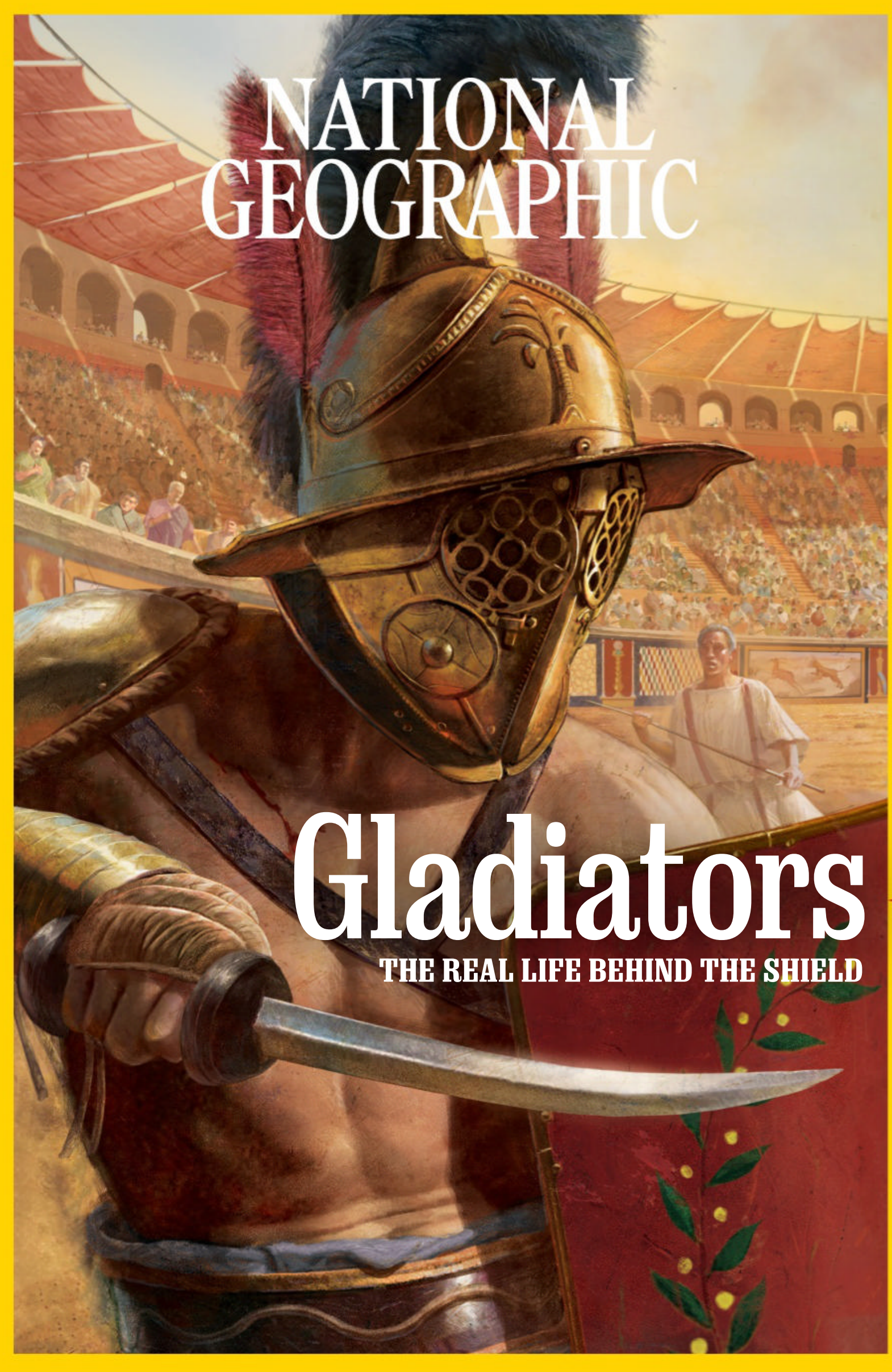


NATIONAL GEOGRAPHIC

Gladiators

THE REAL LIFE BEHIND THE SHIELD

THE PHYSICS BEHIND the iridescent beauty of the northern and southern lights are more or less understood, yet they can still befuddle scientists. Case in point: When the solar wind is weak, a fuzzy patch of auroral lights has sometimes appeared over the north magnetic pole like an ephemeral, glowing spaceship. Early this year researchers were finally able to explain this phenomenon by analyzing data recorded by U.S. Cold War–era satellites on August 20, 2014. They reported that the patch spun in a vortex-like manner; had a calm center with strong "winds" of electrically excited gas, or plasma, zipping around it; and was a gigantic funnel up to 1,700 miles across and more than 31,000 miles high. The scientists dubbed it a "space hurricane" and adapted a 3D model of the movement of magnetic fluids to show how the hurricane formed. The weak solar wind, combined with the alignment of the north magnetic poles of the sun and Earth, constricted a normally expansive swath of northern lights into a tight, rotating spot above magnetic north. Above Earth is the only place these space hurricanes have been spotted—so far.

A QUIET STORM

On Earth, hurricanes are fed from below as moist air rises over a warm ocean. In space, hurricanes need quiet conditions, such as a flipped polarity and low solar wind speed and density.

FLIPPED POLARITY

An expansive aurora happens when the solar wind is strong and Earth's magnetic field points north as the sun's points south. If the solar wind is weak and the sun's magnetic field points north, the aurora contracts into a tight spot above Earth's north magnetic pole—good conditions for a space hurricane.

SPACE HURRICANE

Electron precipitation, auroral ovals, a glowing vortex 31,000 miles high and 1,700 miles across: That's hurricane season at Earth's north magnetic pole.

BY **ROBIN GEORGE ANDREWS** AND **JASON TREAT**
ILLUSTRATION BY **MARK GARLICK**

EVE CONANT AND HEIDI SCHULTZ, NGM STAFF
SOURCE: QING-HE ZHANG, SHANDONG UNIVERSITY

ELECTRON PRECIPITATION

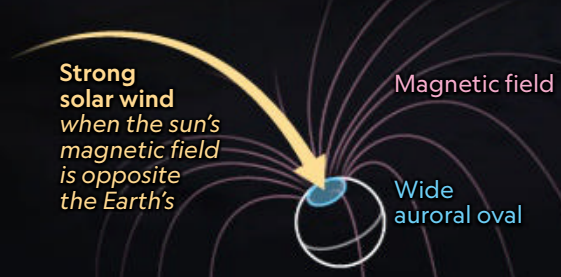
Electrons rain down from the solar wind onto the Earth's magnetic field lines and ping off of gases such as oxygen and nitrogen in the Earth's upper atmosphere. This releases multihued flashes of light known as an aurora.

SWIRLING OVAL

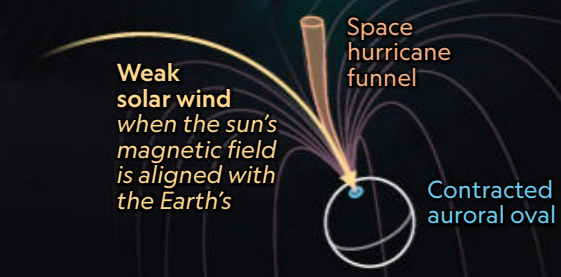
As the opening above the magnetic pole, or auroral oval, contracts, the swirling plasma speeds up and forms a vortex.

THE EYE

Like hurricanes in Earth's lower atmosphere, space hurricanes have a calm eye. Up here, winds of plasma—not air—rush around it at breakneck speeds.



How normal auroras form
Electrons that the sun emits rain down on Earth's magnetic field, causing auroras as they collide with gases. When the sun's magnetic field is opposite that of Earth, it creates a wide opening, or auroral oval, which spreads out and disperses the aurora.



How a space hurricane forms
In 2014 the sun's magnetic field was aligned with the Earth's, creating a weak interaction and shrinking the auroral oval. Electron rain fell on the constricted oval, making it brighter. As the aurora spun, it became very tight, stretching high above the Earth's surface.