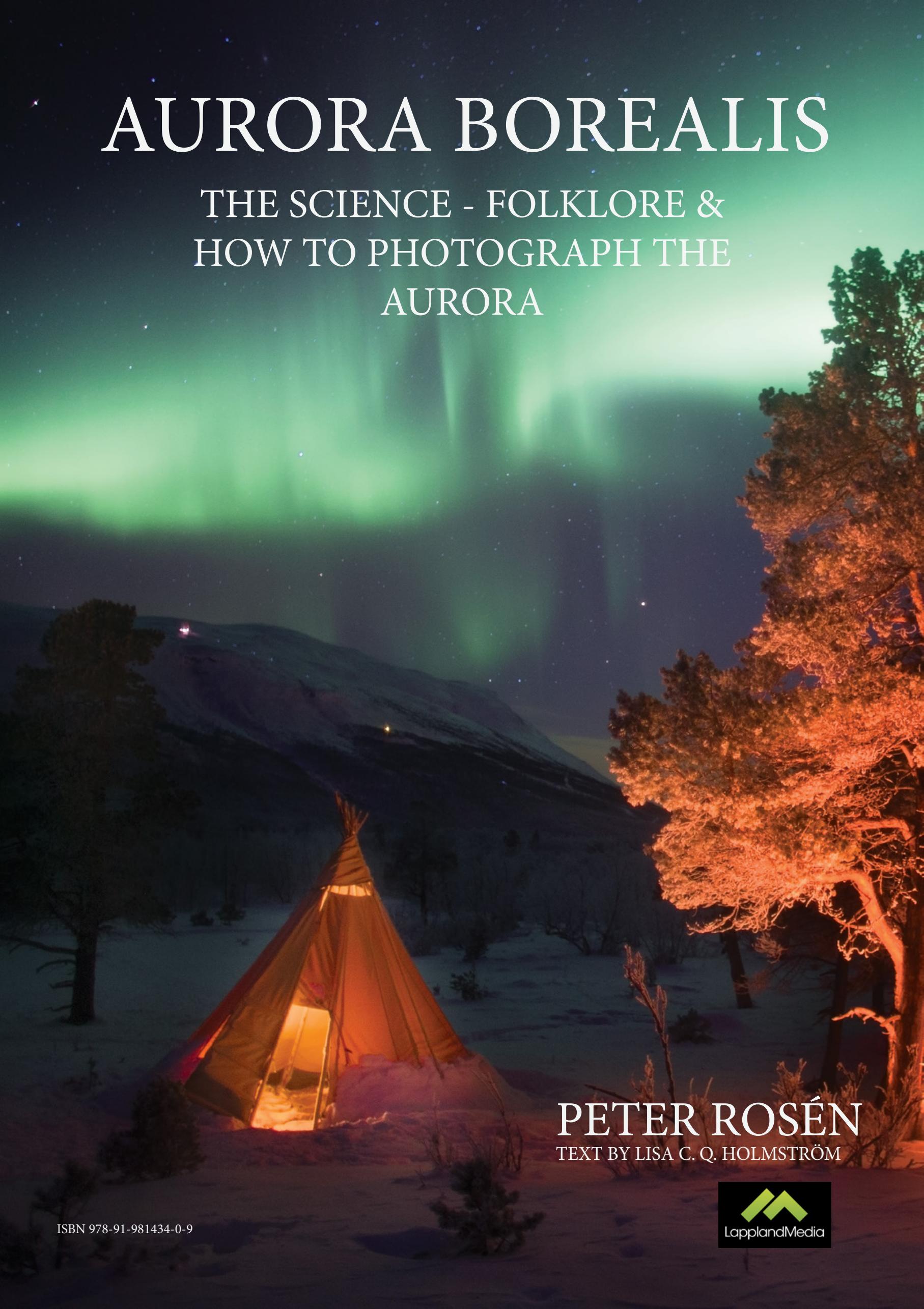


AURORA BOREALIS

THE SCIENCE - FOLKLORE & HOW TO PHOTOGRAPH THE AURORA



PETER ROSÉN
TEXT BY LISA C. Q. HOLMSTRÖM

ISBN 978-91-981434-0-9



Welcome Home

*Brief autumn days
Clear autumn nights*

*Heaven's palette grows cold
Moon, stars wander their set paths
Dancing forth from a foreign land she comes home
The season's first northern lights*

*Untethered
Undetermined
As wild as wild can be
Never makes a sound*

*Someone you have known a long time
Someone never quite understood
Always there watching over*

*Now once again
We shall wander through winter together*

*Spring brings promise of new life
She will leave as gracefully as she came
See you once again in autumn
Dear friend*

Aurora Borealis



WELCOME TO LAPLAND

Lapland is the northernmost areas of Sweden and Finland and part of a greater region called Sápmi, stretching from the northernmost areas of Norway, Sweden, Finland and all the way over to the Russian Kola Peninsula. Sápmi belonged to Sámi people long before national borders were drawn and the name Lapland comes from the old name for the Sámi people, the Lapps. This great expanse of wilderness has been inhabited for only some 10 000 years, just after the last retreat of the inland ice. For thousands of years, the Sámi followed the migrating reindeer, fished the waters and harvested what grew as the landscape developed into what we see today.

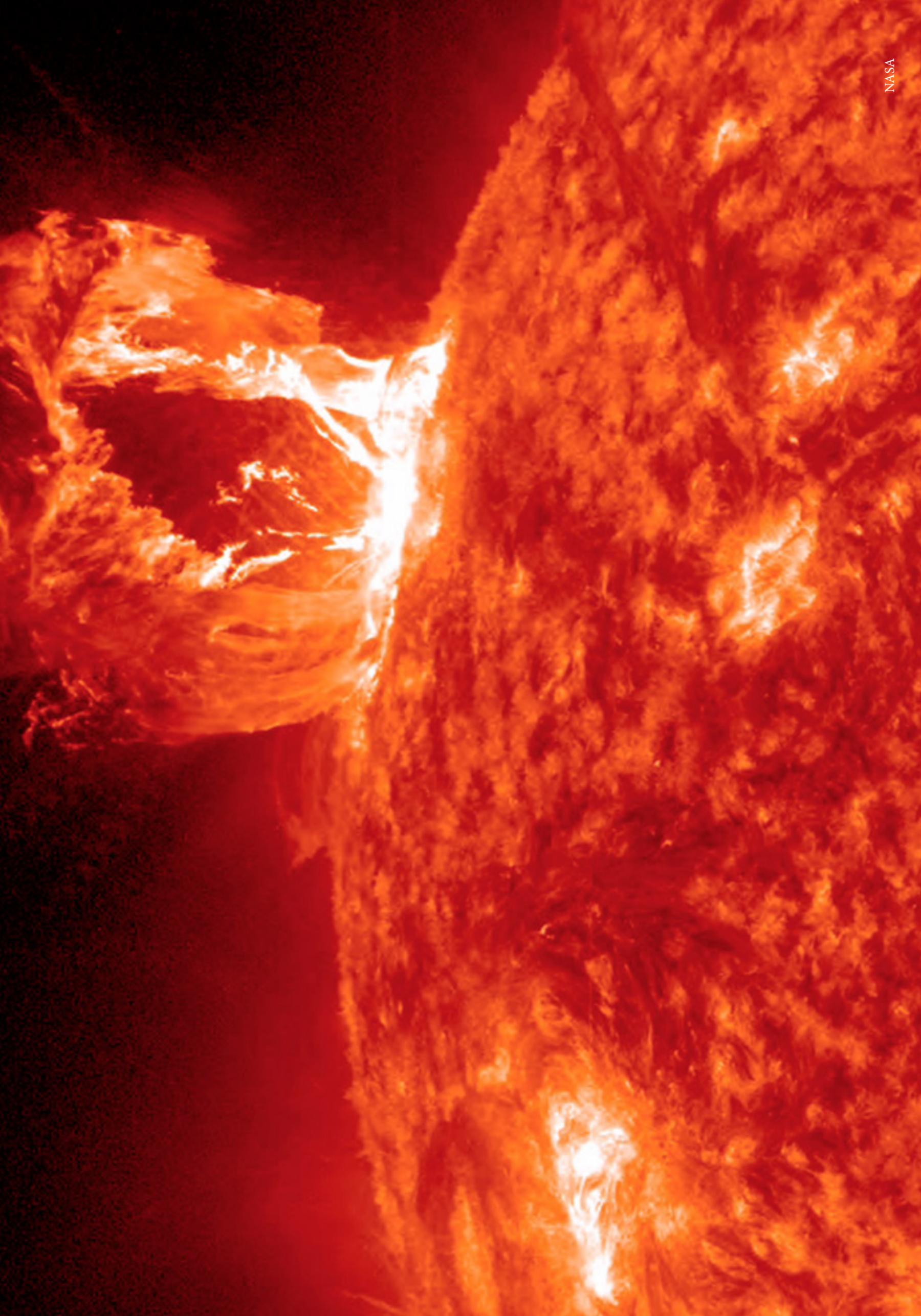
The Sámi were probably the first Europeans to live with Aurora Borealis on a regular basis. The colourful and unpredictable dance in the heavens was shrouded in mystery and was thus given spiritual meaning in folklore and their nature religion. In stories and tales the aurora warns of future catastrophes or encourages respect for the spirit world.

Science has brought us new insight into the physics behind the appearance, motion and colours of the aurora. But being aware of all this does not leave the beholder any less fascinated. Perhaps this knowledge has contributed to an even greater fascination for what is going on above our thin and vulnerable protective atmosphere.

The auroral display of the northern hemisphere is called Aurora Borealis, and the focus of this book. Welcome to a journey into the heart of Swedish Lapland which is considered probably the best place on Earth to see the aurora. We wish to convey the intensity and awe one feels when witnessing the aurora, usually quite oblivious to everything else, including numbing temperatures.

PETER ROSEN
TEXT BY LISA C. Q. HOLMSTRÖM

AURORA BOREALIS
IN LAPLAND



THE SCIENCE BEHIND THE AURORA

To understand the aurora we must begin with our sun, which is a major part of why life on Earth is possible. Without it, well, we would just be another dark rock roaming the universe. It gives us warmth and the light makes photosynthesis possible. But the sun also emits a constant flow of a great deal of energy consisting of high energy particles and other radiation that we need to be protected from. Without Earth's protective shroud of an atmosphere and magnetic field, the magnetosphere, life would probably never have had a foothold on our blue planet. The constant high-energy bombardment would rip emerging life forms apart.

The aurora is the result of an interaction between the sun, atmosphere and magnetosphere. The magnetosphere captures and redirects damaging high-energy particles from the sun and when they collide with the vital gases oxygen and nitrogen in our atmosphere they result in the surreal light and colours of the aurora.

Earth's magnetosphere is built up of magnetic field lines that surround Earth like a bubble, running north to south, all of which penetrate Earth in an oval around the northern as well as southern pole. These field lines are what a compass follows when indicating north. When high-energy particles are captured in these field lines, they are drawn towards Earth at the polar ovals. On their way through the upper atmosphere at about 80 – 300 km above the surface, the high-energy particles collide with oxygen and nitrogen. When they collide, the energy is transferred temporarily to the atmospheric gas particles - they become "excited" - which in turn emit the energy as light. The curtains of light and colours of the aurora are the magnetic field lines being made beautifully visible.

This process is going on constantly above our heads. When the sky is dark enough, and there is enough activity going on in the atmosphere, we can then see this amazing interaction as the aurora. Periods of intense high-energy particle emissions from the sun, called *solar storms*, result in a brighter aurora that can be seen in areas far from the polar regions.

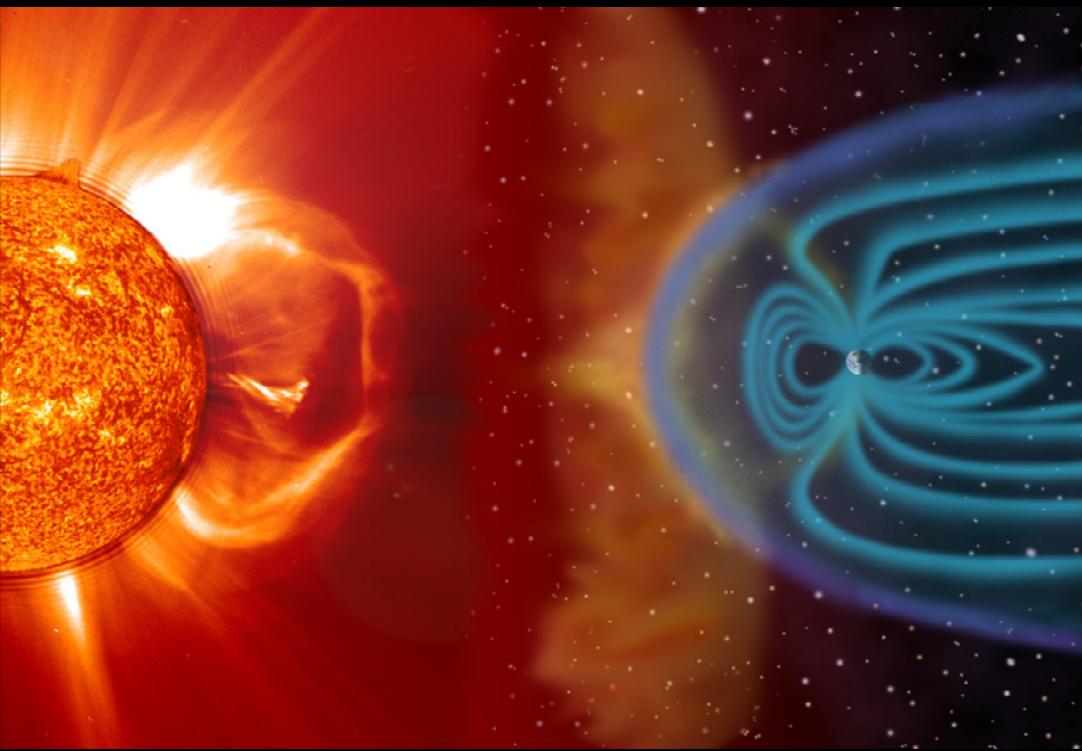


Illustration NASA

An artist's interpretation of the intimate interaction between the solar wind and our otherwise invisible magnetosphere.



Photo NASA

A breathtaking image of the aurora as seen from the International Space Station.

The colours of the aurora depend not only on the type of gas particle being bombarded, but also at what altitude the collisions occur. The dominating emissions tend to be from oxygen, the result being the common greenish glow. But oxygen can also give a red glow when the collisions occur at very high altitudes. Blue is the result of excited atomic nitrogen, and purple molecular nitrogen. Not all energy emitted by the aurora is visible to the human eye, such as infrared and ultraviolet light. Special equipment for the detection gives a full display of what is going on above our heads.

So when you witness the beautiful dance of aurora, you are seeing the intimate interaction of our sun and Earth that has been going on since their very birth, and will continue on long after we are gone.





Living in Lapland means the aurora is never very far off. Seeing the first slight ribbons slowly gliding across the sky a clear autumn evening is like welcoming home a dear friend, comforted in knowing you will once again share the coming winter months together.





The unrivaled queen of the winter sky.

Hypnotizing.

Your heart skips a beat, you hold your breath, dare not blink.



FOLKLORE OF THE AURORA

The full name Aurora Borealis, meaning 'the dawn of the north', was minted by the French philosopher, priest, scientist, astronomer and mathematician Pierre Gassendi in 1621. *Aurora* is the Latin word for dawn as well as the Roman goddess of dawn. The term *Borealis* is derived from the Greek name for the north wind, *Boreas*. The aurora seen in southern hemisphere was similarly named then *Aurora Australis*, 'the dawn of the south'.

As long as Earth has had a magnetic field and atmosphere, there must have been aurora. The heavens have always been there to be observed, with the regular and slow movement of the sun and moon, constellations turning with the seasons. Apart from the occasional eclipse, meteor showers and sweep of a comet, the aurora was, just as it is now, absolutely thrilling to behold with its flashes of colourful dancing lights. Their mystery ran deeper since the appearance could not be predicted as soon as the seasons turned to give way to the long period of midwinter nights. And during exceptionally powerful displays, the aurora stretched farther south than normally expected, giving people living there something to really think about. So it is not surprising that almost every culture able to witness the aurora have also searched for explanations to the phenomena.

A great deal of man's understanding of the world around him also played in to the attempts to more scientific explanations. Some thought the flashes of light at night may be from the fires that surround the oceans. Others that they may be sunlight seeping over from the day-light side or are reflections from the mighty glaciers to the north.

Folklore from different cultures living under the aurora oval offers quite a few more imaginative explanations. From Scandinavia, one of the many old names for Aurora Borealis is *sillblixt*, or herring flash, in the belief the flashes of light were reflections of great schools of herring at sea. For those living in southern Scandinavia, it was speculated to be the light from the Sámi with torches running about in the mountains looking for their reindeer. Or that swans had competed in whom could fly farthest north, and those who flew the farthest froze. When they flapped their wings in attempts to break loose they caused the aurora. The Finnish name for Aurora Borealis is *revontulet*, foxfires. The legend tells of the fire foxes of the north, whose furry tails let off sparks as they ran over the mountains.





Now, depending on which part of the world the aurora appeared had quite an impact on how it was perceived. In the more southern regions of Europe, where the aurora was considerably less common and most often appeared in hues of red, it was feared, thought to be the harbingers of coming war, plagues and other hardships that man unfortunately suffered through on a rather regular basis. A convoluting red sign in the sky could not mean anything good.

For those living to the north, where aurora was a more regular feature of the winter season, it was regarded with respect. For the Sámi, as well as people living in northernmost Europe, Asia and America, Aurora Borealis was the home of the dead. Foremost those who had suffered violent or early deaths came with the lights. These could be children, women who died in childbirth, those murdered or fallen in battle. So naturally they were to be met with respect when they came to visit. A more playful interpretation is found in tales told by the Inuit of Greenland and northern Canada who thought the spirits were playing soccer with the scull of a walrus. Their name for aurora is *aqsaljaat*, 'traces of those who play soccer'. Those watching these traces of the thrilling game regarded it carefully, for otherwise they risked having their own heads knocked off by a flying walrus skull. For all these cultures, it was forbidden to tease or misbehave during the auroral display, for this was extremely disrespectful.







The Sámi once thought the aurora was somehow connected to the weather, believing that when the flashes stretched high into the sky, warm weather could be expected. Living in a cold climate meant sometimes doing all you can to make things better. So, by attempting to awaken the aurora, you could also affect the weather. One way was to repeat a little rhyme about the dancing lights, *gotseth lipi, lipi* meaning 'aurora flash, flash'. Another way to coax the appearance was to wave about a white sheet. Warmer weather always did return after the long midwinter nights, whether the coaxing hurried the seasons along remains unknown.







PROBABLY THE BEST AURORA ON EARTH

Swedish Lapland, and especially Abisko, is considered probably the best place on Earth to witness the aurora. There are three main factors that make Swedish Lapland very favourable, and a few other minor but ever so important aspects that make the experience absolute bliss.

To begin with, the northern auroral oval happens to run right over the northern regions of Canada, Alaska, Finland, Norway and Sweden. The second factor has to do with the Gulf Stream that brings warm tropical water up along the Norwegian coast, resulting in a relatively comfortable climate compared to similar latitudes in for example Canada. The third factor has to do with Abisko being situated in what is called a precipitation shadow. This is the result of the high mountain range running along the Norwegian-Swedish border west of Abisko. When the precipitation coming off the North Sea rises over the mountains, it rains or snows, dissipating the inclement weather once reaching the other side. Abisko is thus both poor in rain and snow, rich in more clear skies than anywhere else in the region. Perfect for viewing auroras once the sun has set.

The geophysical and climatic advantages of Swedish Lapland and Abisko are perfectly complemented by other aspects that make the aurora so very available. The Sámi lived here for thousands of years and left the landscape unscarred by modern infrastructure. Over the last century, the mining industry, scientific research and tourism led to the establishment of public infrastructure in the way of railways and roads. With the pioneers came villages and towns, making it easier to stay for an entire season to observe and record the aurora with all the comforts of home. And finally, Abisko offers dark night skies free from the disturbing pollution of artificial light.



The Aurora Sky Station in Abisko National Park offers an impressive view of our subarctic mountain landscape and probably the best aurora on Earth.

Step into the midwinter night. Take comfort in the allure of a silent landscape, the unwavering path of our companion moon.

Be seduced by the untethered dance of Aurora Borealis.





Witnessing such an unharnessed display is a truly overwhelming experience.

The final words of a short conversation overheard between two friends awestruck by Aurora Borealis sums it up so well:

"It is so beautiful it hurts."



The quivering bow of Aurora Borealis has performed passionately throughout the evening.
The silence lends time to reflect.





Eternal Aurora love

It has been said that witnessing the aurora with your true love brings a lifetime of happiness to your bond.

"Love is a mystery", they say. And well, so too is the dance of the aurora.

It is eternal, unpredictable, grand.

It cannot be contained or ever fully described.

Gaze upon the aurora as you gaze upon your love.

In awe.





LAPLAND THE ACCESSIBLE

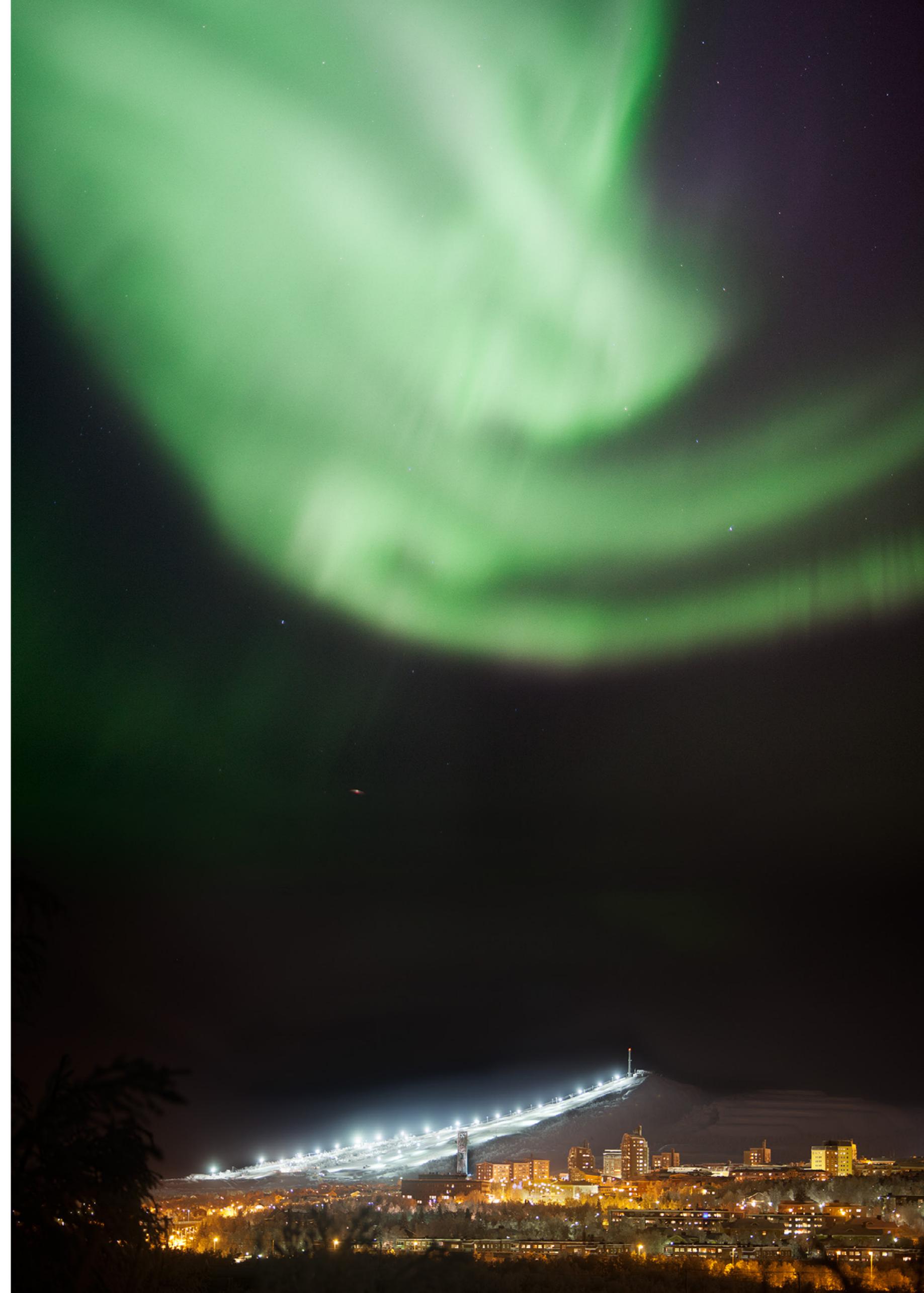
At the turn of the 1900's, there was a surprising amount of activity for such a far off place like Swedish Lapland. Consider there were no real roads connecting the region to more established towns on the coast. The waterways were pretty much the only mode of swift transportation. Once land-bound, you had to rely on preliminary maps and the kindness of guides. The winters were just as long, cold and dark as they are today. And the summers in turn just as brief, intense and at times intolerably buggy. This was certainly not the most attractive place to set up any sort of operation, unless of course you had very lucrative or scientifically special reasons. And it was just the investigation of Aurora Borealis and mining for iron ore that drew people here despite.

The railroad was established to facilitate the movement of the precious iron ore from the mountains to the coasts. With the railroad came tourists wanting to experience the untouched beauty, and scientists and naturalists curious to learn more about the exotic flora and fauna of Lapland. This is when the Abisko National Park was established, soon thereafter the research station which is still active today.

Among the scientists to trek to these northernmost latitudes were those just beginning to open the door to understanding just how Earth, the Sun and Aurora Borealis are connected. Research stations were set up early on in Norway, Sweden and Finland for observing, measuring and collecting data on the aurora.

Today, a little more than a century later, the drive to mine, trek in the mountains and learn more about the inner workings of Aurora Borealis continues to thrive. The mine is much deeper, the tourists come from every corner of the globe and the research now reaches beyond the realm of Aurora Borealis, farther than anyone could ever have imagined.

Swedish Lapland is unique in so many ways, and never ceases to capture the imagination of those who visit. Long after the mine is depleted and the last rocket has been launched out into space, man will still come and sit on a hillside one chilly winter night and watch as the first aurora ribbons make their way across the heavens, erupting into a magnificent display. He is left breathless. It is very possible every detail of the aurora physics has by then been worked out and the phenomena is no longer the least bit a mystery. Nonetheless, there he will sit, still amazed that they exist at all.





Mankind toils unceasingly to exploit the one and only Earth she has. Her stiff and cold strife
for more energy, more light, and more things non-eternal stand in strong contrast to the
flighty aurora.

Aurora Borealis embodies the energy, light and beauty mankind yearns to capture.

Here it is free for the taking.

Enjoy.







Seemingly unaware of the auroral display unfolding above their heads, this team of huskies patiently waits as their mushers warm themselves around the crackling fire.





PHOTOGRAPHING AURORAS

Among the most important things to think about when photographing aurora is to hold the camera still. If you do not have a tripod, place your camera on the ground or anything else steady, direct the lens towards the aurora and take the picture. If your camera has settings for exposure times, allow for as long exposure as possible, 10 – 30 seconds is usually enough. If you have a little more experience and your camera allows for manual settings, try the following tips to capture your aurora image in the best possible way:

Before you set out

Make sure you take with fully-charged batteries since they quickly run down out in the cold. Choose a camera with a wide-angle lens and place it steady, preferably on a tripod. A compact camera will work well, but a digital SLR camera will enable better images. Since all the adjustments are done in the dark, it is a good idea to become well-acquainted with your camera and perhaps read through the instruction book one last time before you set out.

Take a head lamp with you. The light is convenient when adjusting your camera settings, but also very useful for lighting up a nice foreground. For example it could be nice to light up a person or something else in the image. A flash unfortunately gives an unnatural lighting and can spoil the atmosphere you want to convey in the image.

Out under the aurora

Set your camera to ISO 800 or higher. With the newer cameras you can set the ISO higher without too much noise in the image. Open the aperture as wide as possible, between f2.0 and 4.0. A wide-open aperture allows for more light to reach the sensor per second.

If you do not have a foreground, set the focus to infinity to make the stars sharp. With a wide-angle lens you can focus on an object ten meters away and still capture both beautifully sharp aurora and a star-studded sky.

The exposure time varies depending on your ISO and aperture settings as well as how strong the aurora is. A simple tip is to take a picture, evaluate it on the LCD screen or histogram and make adjustments from there. If the image appears too dark, increase the exposure time. It can be anywhere between 5 – 60 seconds.

When you are done photographing, place your camera in an airtight bag before taking it inside. Otherwise you risk condensation in the camera. Let the camera warm up inside the bag before taking it out in room temperature.

Do you want to continue exploring your possibilities of photographing aurora? You are welcome to join Peter Rosén's Aurora Borealis photography courses in Abisko National Park and Kiruna. For more information, please visit Lappland PhotoAdventures at www.lapplandphotoadventures.com.



NORTHERN LIGHT ADVENTURES IN LAPLAND

Abisko National Park - activities and hotels

Abisko Mountain Lodge www.abiskomountainlodge.se
Abisko Mountain Station www.svenskaturistforeningen.se/abisko
Aurora Sky Station www.auroraskystation.com
Lapland Resort www.bjorkilden.com

Aurora PhotoAdventures in Abisko National Park

Lapland PhotoAdventures www.lapplandphotoadventures.com

Kiruna/Jukkasjärvi - activities and hotels

Girontravel www.girontravel.se
ICEHOTEL www.icehotel.com
Jukkasjärvi vildmarksturer www.jvt.se
Kiruna Guidetur www.kirunaguidetur.com
Nutti Sámi Siida www.nutti.se
Ofelas www.ofelas.se
Ripan www.ripan.se

Aurora PhotoAdventures in Kiruna/Jukkasjärvi

Lapland PhotoAdventures www.lapplandphotoadventures.com

Aurora images online

Lapland ImageBank www.lapplandimagebank.com

Aurora products/gifts online

LaplandMedia www.lapplandmedia.com

Learn more about the scientific side of the aurora adventure at the Swedish Institute of Space Physics in Kiruna www.irf.se



Thanks to ...

Abisko Mountain Lodge
Abisko Mountain Station
Aurora Sky Station
Ann Wikström
Annette Niia
Brutus Östling
Camp Ripan
Canon
Hans-Olof Utsi
Jukkasjärvi Vildmarksturer
Kiruna Guidetur
Kiruna Lapland
Mats Holmström

My Rosén
NASA
Nicki Eby
Nuttu Sámi Siida
Per Karlsson
Petra Sternlund
Putte Eby
Roine Magnusson
Stefan Mårtensson
Swedish Institute for Space Physics
Tentipi® Nordic tipi
Uwe Raffalski

... without your help, this e-book would not have been possible!

All images in this e-book were
captured with Canon
equipment



All Tipitents shown in
this book were provided
by Tentipi



A subject worth exploring

Literature devoted to Aurora Borealis, in science as well as folklore, is both incredibly extensive and very international. With the Internet at our fingertips, this natural phenomenon is today easy and wonderful to explore. The foundation for this book is the comprehensive and entertaining information provided by the book Norrsken – budbärare från rymden (Northern Lights – messengers from space) by the Swedish Professor Ingrid Sandahl (1949 – 2011) who researched the inner workings of aurora at the Institute of Space Physics in Kiruna.

Rosén, Peter
Aurora Borealis in Lapland
Text: Lisa C.Q. Holmström
Book Publisher: LapplandMedia
Edition 2013
ISBN 978-91-981434-0-9

©LapplandMedia/Image Bank
©Images: Peter Rosén and NASA 2012 (p 6-8)
©Text: Lisa C.Q. Holmström

All rights reserved. All copying, and distribution on internet is prohibited without a written permission by LapplandMedia. Also applies to copying for educational use.

Graphical design: Peter Rosén/LapplandMedia
Repro service: ELIB