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ROYAL OBSERVATORY GREENWICH

NORTHERN LIGHTS

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Contents

4 Introduction

History of the Northern Lights

5 Etymology
6 Northern Lights in antiquity
10 Mythology and interpretation
21 Early scientific thought and investigation
25 Modern research, experimentation and the Space Age

Science of the Northern Lights

34 The space weather environment
35 A journey in the solar wind
38 The Earth's magnetosphere
41 Formation of auroras in the atmosphere
44 Auroral colours and altitudes
46 Dynamics and types of auroras
50 Space weather storms
57 Solar cycles
59 The Northern Lights from orbit
62 Auroras on other worlds
68 Related phenomena

Guide to aurora chasing

72 Where to see the Northern Lights
74 When to go
78 Aurora forecasting
81 What to look out for
86 Aurora-chasing tips

Aurora photography

87 Aurora photography equipment
90 Camera setup and shooting
91 Getting creative
94 Processing your photos

102 Online resources
103 Apps and software
104 Glossary
108 Acknowledgements

Introduction

There is infinite suggestion in this phenomenon, and in that lies its charm; the suggestion of life, form, colour and movement never less than evanescent, mysterious – no reality. It is the language of mystic signs and portents – the inspiration of the gods – wholly spiritual – divine signalling.
Remindful of superstition, provocative of imagination.

On 21 May 1911, almost eleven months into his ill-fated British Antarctic Expedition, polar explorer Captain Robert Falcon Scott remarked in his diary on an extraordinary display of the Aurora Australis – the Southern Lights – during which he saw flushes of red appearing alongside the typical green with which he was familiar. With these words taken in isolation, it seems it must have been quite a sight because Scott, himself no stranger to the Lights, composed his account with remarkably romantic language. In fact, he was overwhelmed not once but often, and he seemed to find continuous inspiration from the displays he witnessed above the frozen wastes of the Antarctic pack ice. A month later, at midwinter, he wrote:

It is impossible to witness such a beautiful phenomenon without a sense of awe, and yet this sentiment is not inspired by its brilliance but rather by its delicacy in light and colour, its transparency, and above all by its tremulous evanescence of form.

He further opined on its subtlety and spiritual suggestion, illustrating its character as 'serenely confident yet restlessly mobile'. His words are a feast for the imagination



The Aurora Australis *painted by George Marston (c.1909)*

and do real justice to something that is very difficult to describe. Being a lesser writer, the most I can add is that seeing a bright and colourful auroral display is like seeing something taken from a dream made real in front of your eyes. There is no adequate substitute to witnessing it yourself. Whether it is the first time, or one of many times, you too will be bound by the same spell that compelled Scott to pen these accounts.

Fortunately, you don't need to venture to the harshest continent on Earth to experience this phenomenon. The Northern Hemisphere, where most of us live, offers myriad considerably more accessible climes from which the Northern Lights – no different from or less spectacular than Scott's Southern Lights – are widely visible at certain times of the year. Several million people live within the Arctic Circle, where the Northern Lights are simply a part of the night-life; others are sufficiently far north to witness them during highly active periods although they may simply not know when to look; most of us, however, are too far from the Arctic and must plan a trip north – a kind of polar expedition of our own.

The purpose of this book is to give you a complete understanding of the Northern Lights. This includes their historical and mythological context, our modern scientific explanations of their cause and nature, and a comprehensive guide to forecasting, stalking, and photographing auroras yourself. With the aid of the tools and tips discussed in these latter chapters, you will be able to comfortably sidestep the world of aurora tourism and take the chase into your own hands. I hope that your first (or next) sighting of the Northern Lights is not far away, and that this guide will help you to make the most of it. No matter how remote or blisteringly cold it may get, the reward is among the most magical experiences available anywhere on the planet. It's well worth the adventure!

HISTORY OF THE NORTHERN LIGHTS

Etymology

In literature, you will find the interchangeable terms Northern Lights and Aurora Borealis. Both refer to the same phenomenon and it is difficult to ascertain which term is more popular – even the title of this book required extensive consideration! The name Aurora Borealis was first used by the Tuscan scientist Galileo Galilei in 1616, in reference to rare sightings of shimmering light, known about since ancient times. It is unclear whether he witnessed the outburst of auroral activity over Europe nearly ten years earlier in 1607 or rather inferred its appearance from accurate, second-hand accounts – for example, from his contemporary Johannes Kepler. Either way, he believed the phenomenon was related to sunlight reflecting off the atmosphere, and he employed the then-popular convention of using natural mythology in his naming scheme. Aurora is taken from the Latin word for dawn – also the name of the Roman goddess of the dawn, who was described in Greek poetry as having rosy fingers. This is a playful nod to the reds and pinks of the eastern sky before sunrise, and it is appropriate when considering the similar colour of auroral curtains visible from southern Europe, where the green is extremely uncommon. Meanwhile, Boreas is the Greek god of the northern wind and sometimes of winter. From here we also extract the term boreal, to describe people or places in the north. The Aurora Borealis then, is the Dawn of the North. Similarly, Aurora Australis is the Dawn of the South. We can also describe them collectively as the Aurora Polaris (Polar Dawn) and pluralise them as auroras or aurorae – both are correct.

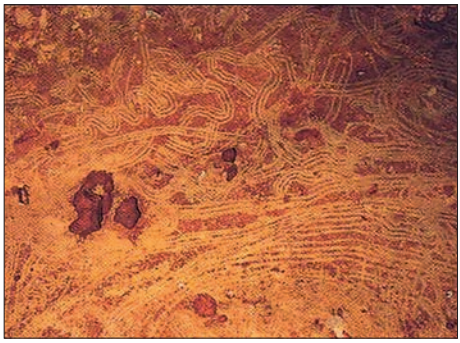
Perhaps Galileo was pleased with the terminology he invented when, in 1621, an auroral outburst of tremendous power

illuminated the sky over his home in Venice. From Mediterranean latitudes, auroral displays necessarily take on a pronounced red hue, and this fact influenced its reception among ancient natives of the region, as we will see. Certainly, it could have been mistaken for an impending sunrise in an unfamiliar and typically impossible part of the sky. Aurora Borealis is an international scientific term – not the first or the last to be coined by the father of modern science – but in the English-speaking world, Northern Lights is generally easier to decipher. It sounds like a modern, simplified and translated name, but it is in fact older than its fancy Latin counterpart. A Norwegian text, written in Old Norse in 1250, mentions norðrljós – simply, 'northward light' – encountered by settlers of Greenland. In contemporary Icelandic, which is virtually unchanged from its roots, they are norðurljós; in Danish, a modern Nordic language: Nordlys. As a result of Scandinavian-Germanic confluence, the German term is nordlicht. It is fair to say that Northern Lights is an experiential name, whilst Aurora Borealis is more classical in scientific nomenclature.

The practical and historical aspects of this guide are focused on the Northern Lights and not the Southern Lights, but it will be useful to discuss the broader category of Polar Lights in order to delve deeper into the science. Because all share the same natural origin, they will generally be termed auroras throughout the book.

Northern Lights in antiquity

It is a curious thought that at some point, a singular human whose identity we will never know became the first person to witness the Northern Lights, although that strange sight was likely very soon shared with a group of fellow prehistoric nomads. Where and when this took place will remain a mystery. On very rare occasions the Northern Lights can reach much farther south than we might reasonably expect – for example, in 1859 they were seen in Puerto Rico and Hawaii at latitudes of just 18-21° north – so it seems probable that sightings occurred long before our early human ancestors reached Europe or Asia. Perhaps the first known record exists in cave-paintings made by early European modern humans (often termed Cro-Magnons) a few tens of thousands of years ago. A painting of snake-like ribbons, nicknamed *macaronis*, has been put forward as a possible depiction of auroral curtains in the sky. We know that these settlers were enchanted by the night sky and very aware of its seasonal changes – constellations were recorded in numerous Palaeolithic cave paintings – but with no written record to go by, this potential illustration of the Northern Lights remains a matter of speculation.

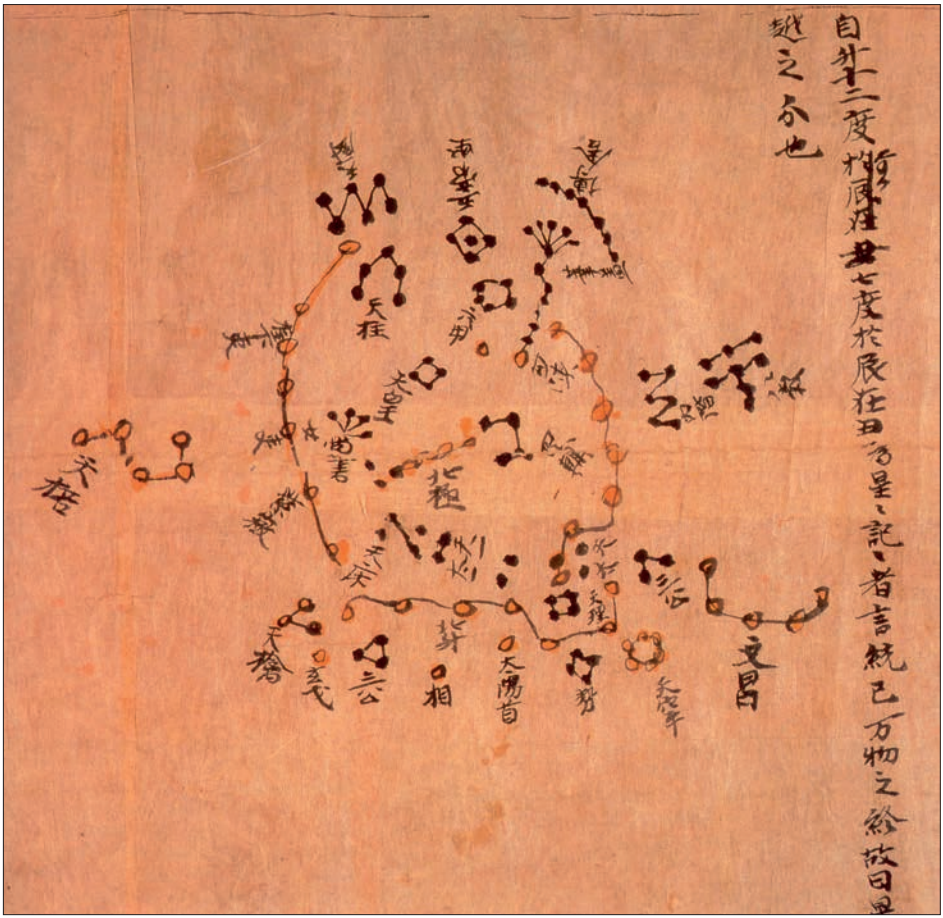


Macaronis are possibly auroral ribbons depicted in early European modern human cave art

One somewhat less disputed but much more recent account comes in the form of traditional storytelling from ancient China, about 2600 BCE. The written tale describes Fù Bǎo – the mother of deities known as the Yellow Emperor and the Flame Emperor – seeing a persistent light in the sky (translated as lightning) circulating around the star Tiān Shū of the pattern Běi Dǒu, and which was bright enough to illuminate the fields below. Whilst the word for lightning is used, it is an unusual kind of lightning that lingers, moves in a circle and forms

apparently free of clouds. We can infer that the sky was not overcast, because otherwise the stars would not be visible. Another important clue lies in the identification of the star pattern, the Chinese constellation Běi Dǒu, which is the asterism known as the Plough or Big Dipper to western stargazers. The star called Tiān Shū is Dubhe (or α Ursae Majoris) the second brightest star in the constellation of the Great Bear. It's one of the two 'pointers' used by stargazers to identify the North Star – and therefore true north – as it lies within the northern reaches of the Celestial Sphere. As such, this star is always seen somewhere over the northern horizon, and so the 'lightning' witnessed by Fù Bǎo around Dubhe was a bright, moving northerly light. Whether this can be considered the first written account of an auroral display is a matter of debate, but ancient Chinese sky-watchers certainly did go on to make definitive records during the Middle Ages.

In Europe, in 593 BCE, an arresting display of the Northern Lights seen from Greece inspired natural philosophers to speculate on their origin. The mathematician Hippocrates of Chios (not to be confused with his contemporary namesake of Kos, the



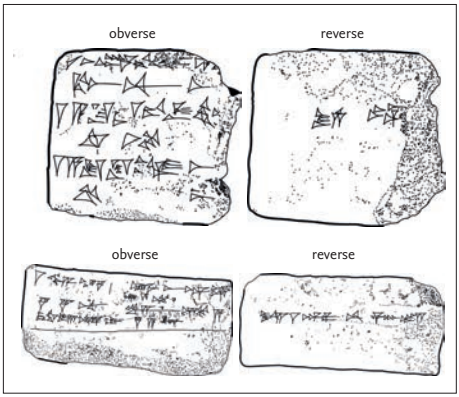
Běi Dǒu (the Plough or Big Dipper) depicted with northern polar stars on the Dunhuang Star Chart (c.700)



Hippocrates of Chios

'father of medicine') was the first to propose, alongside his student Aeschylus, that the phenomenon occurred when sunlight was reflected in some way by the sky – an idea much later revived by Galileo. This display has been proposed by some Biblical scholars as a candidate for the 'storm wind out of the north' described in the book of Ezekiel. It appears as a vision for the Hebrew prophet during the first year of his exile in Sumer – now Iraq – which has been dated with reasonable confidence to be 593 BCE. Ezekiel (or the anonymous author of the book) describes the storm as a whirlwind or windstorm, surrounded by light and with a fiery core like glowing metal with the colour of amber. Perhaps in this case, as might also be true with Fù Bǎo's vision, we are receiving a true account through the lens of allegorical or superstitious embellishment. Ezekiel is said to have been living about a hundred kilometres south of Babylon, with a latitude several degrees farther south than the Greek islands, but we know that the Northern Lights were occasionally seen here. For example, a Babylonian cuneiform tablet records a sighting by one of King Nebuchadnezzar II's royal astronomers in 567 BCE. Babylonian celestial records

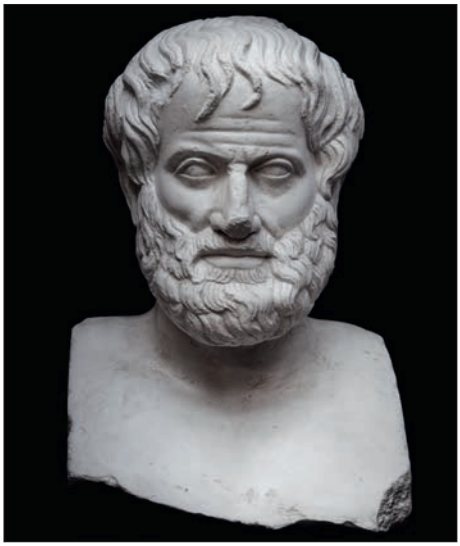

Ezekiel's vision of light in the north may have been inspired by an auroral display



Babylonian cuneiform tablets created between 679-655 BCE describe a 'red glow' and 'red cloud'

are first-rate sources of astronomical observation from this period of history.

Back in Greece, philosophers began to make increasingly more scientific studies of the Northern Lights, presenting various hypotheses involving natural causes. For example, in the 4th century BCE, Heraclides Ponticus suggested that auroral curtains were a rare form of self-luminous clouds, which is not unlike the impression many people experience at first sighting. He and his contemporary, the venerable Aristotle, may have witnessed the Lights on more than

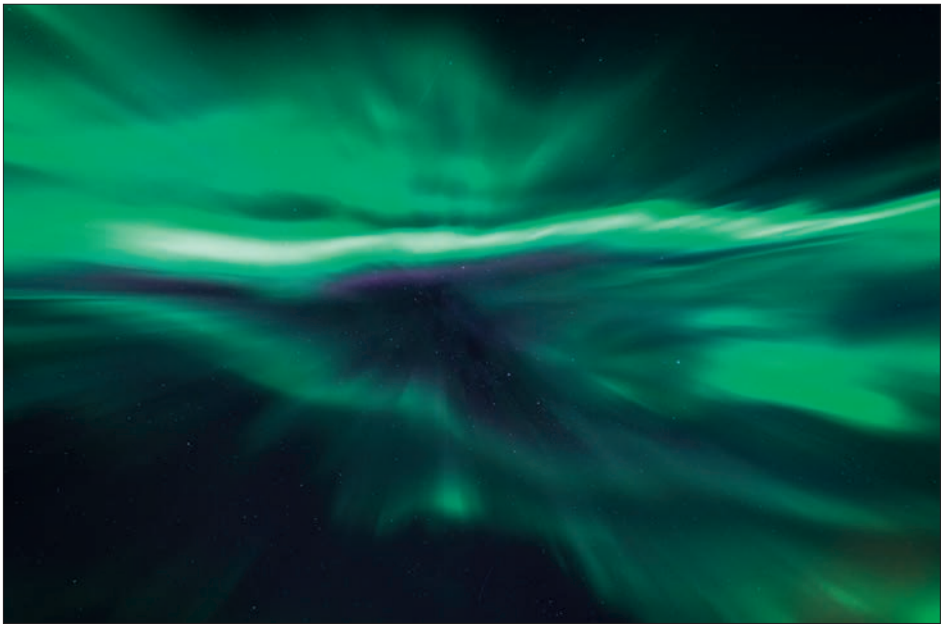


Aristotle took a scientific approach to explaining the Northern Lights

one occasion during outbursts in 349 and 344 BCE. Aristotle favoured the earlier view of involvement from the Sun, but he framed it within his own interpretation of the elemental model of nature that was popular at the time. In his hypothesis, steam rising from the Earth into the sublunary sphere met with fire from the Sun. The ignition of the vapours, he said, produced colourful



Natural philosphers in ancient Rome continued the tradition of Greek scientific thought about auroras



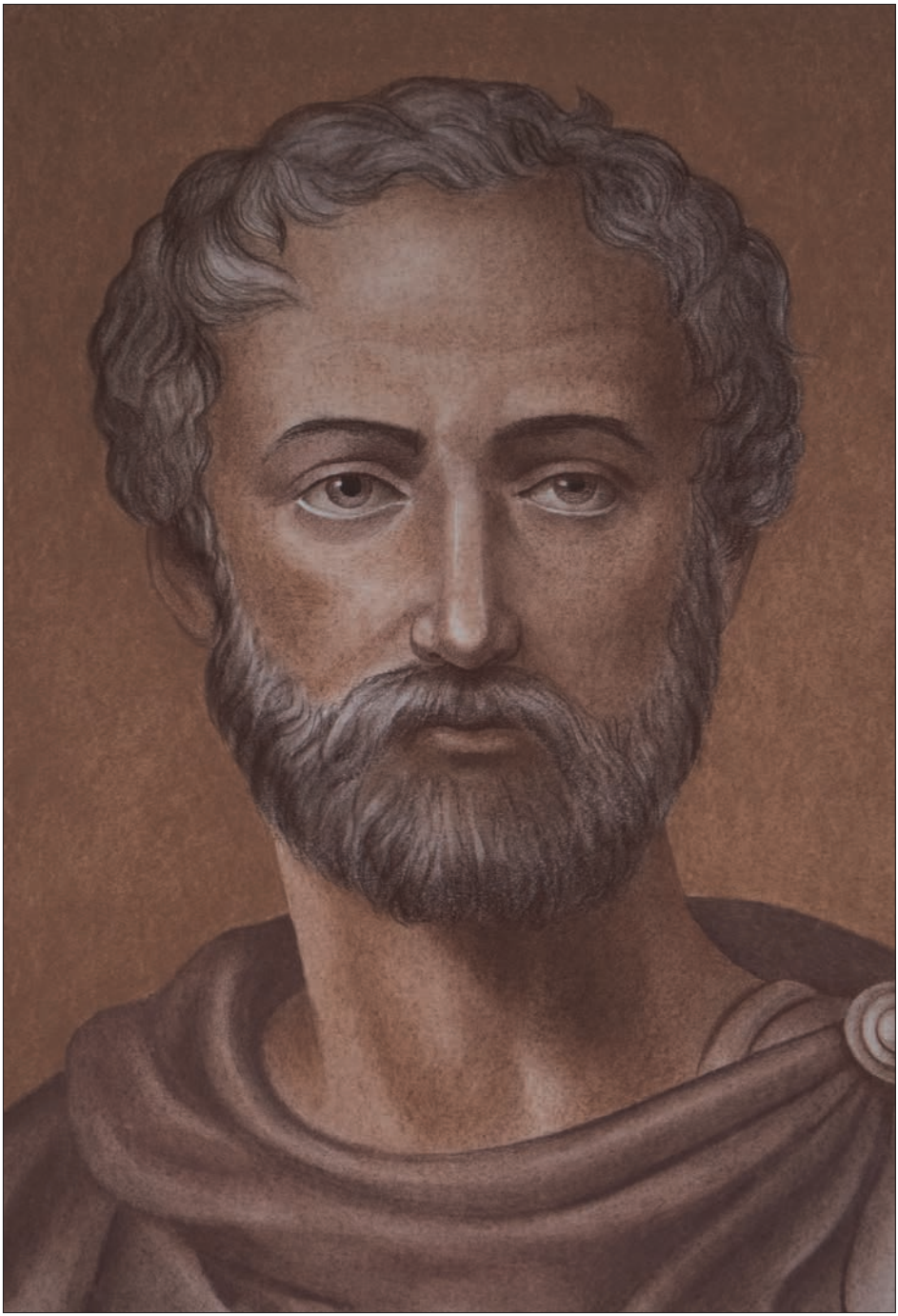
Seneca the Younger describes an auroral corona, though he probably did not see one himself

flashes of light. It is a testament to Aristotle's insatiable scientific mind that this primitive proposal is surprisingly close to the truth, in that auroras really do occur due to the interaction of matter from the Sun and the Earth's atmosphere.

A flurry of quasi-scientific accounts of the Northern Lights comes to us from ancient Rome, in the 1st century of the common era. Seneca the Younger must have received an accurate description of an overhead display – it is unlikely he saw one himself – as he outlined the experience of peering upward into an auroral corona in detail, in his essays on the natural world: *Naturales Quaestiones*. Notably, he refers to '*…a great gap in the sky like a hole dug in a circle*.' A more influential work, *Naturalis Historia* by his contemporary Pliny the Elder, recalls historic tales of light appearing with the colour of blood in the sky. But this author, not swayed by mysticism, suggested that rather than being supernatural events portending ill fortune, auroras were instead simply retconned as omens by superstitious minds. He wrote: '*They have indeed been forerunners of exceeding great miseries, but I suppose those calamities happened not because these impressions were, but these therefore were procreated to foretell the accidents that ensued afterward*.' Published in 77 CE, it is one of the last known works to give such a measured view of this unexplained curiosity, before a great veil of superstition descended over European thought about the natural world. Roman traditional storytelling increasingly connected unusual natural phenomena with portent and fear. After the Empire fell, the early Middle Ages brought a period of more than a thousand years with no progress towards understanding the Northern Lights.

Mythology and interpretation

In his short discourse on the Northern Lights, Pliny the Elder refers to King Philip II of Macedon (Macedonia) whose campaign to invade Greece in the middle of the 4th century BCE was allegedly signified by blood



Pliny the Elder's Naturalis Historia *was an influential encyclopedia in the ancient world*



Auroras preceded Philip II's assault on Greece, which culminated at the Battle of Chaeronea in 338 BCE

red auroral displays seen across the region. In 44 BCE, the apparition graced the skies of Rome not long before the assassination of Julius Caesar – an omen in retrospect to some. Even in Pliny's own lifetime, the siege and destruction of Jerusalem at the hands of Emperor Titus was said to be preceded by a bright, moving swath of light in the night sky that resembles accounts of the Northern Lights.

At such southerly latitudes as these, the Northern Lights do not appear as well-defined, green ribbons flowing graciously



Julius Caesar's assasination was retrospectively claimed to have been preceded by auroral omens



The siege of Jerusalem by the future emperor Titus occurred nine years before Pliny's death

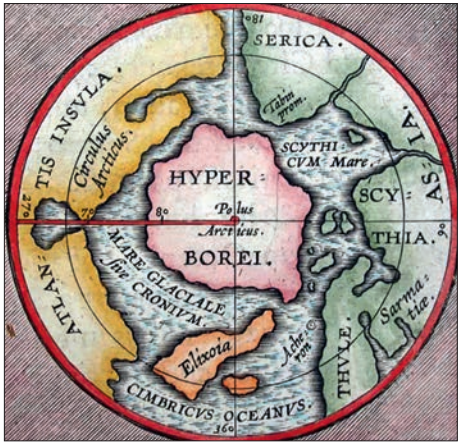


High altitude auroras are predominantly red in colour, so at southern latitudes, rare displays are entirely red



Uncommon red auroras fueled superstition across much of medieval Europe

through the sky like the cover photo of this book. Rather, they are confined to the northern horizon and strictly red or orange in colour, if any colour is seen, because from the perspective of southern observers only the tops of the auroral curtains are visible. Additionally, features close to the horizon are reddened in much the same way as the sunset by the atmospheric filtering of blue light. In the next chapter, you will see how different colours are formed at different altitudes above the ground. It's easy then to see why people unfamiliar with auroras would liken them to fires and draw negative associations to them, but there is a much richer tapestry of storytelling about the Northern Lights among the many diverse communities that settled at northern latitudes, where auroral displays are a regular feature of the night sky. These myths are seldom rooted in fear. Instead, the most common themes are prosperity, birth and death, comforting light, merrymaking, animal spirits, and soul-journeys to other realms.



Writers in the ancient world were fascinated by the continent of Hyperborea, which was thought to be lush and green



Inukshuk sculptures constructed by Inuit nomads guided travellers across the harsh northern reaches



Children play a ballgame with a walrus skull, as decpted by Inuit artist Germaine Arnaktauyok