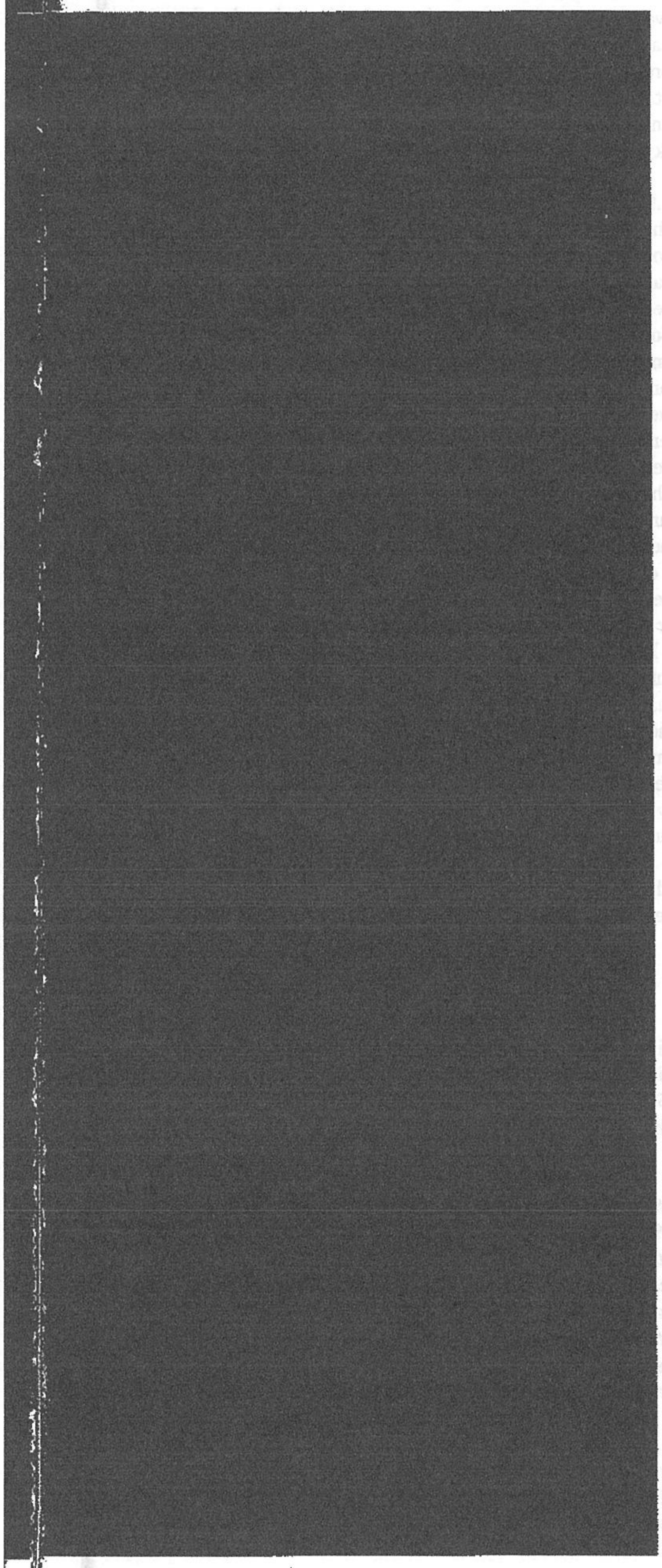
Orion - Winter



# Earth's Many-Colored Mantle

*by Arthur G. Zajonc*

Darkness, we say, is simply the absence of light; but is it really? Imagine yourself suspended in the midst of nowhere, no objects round you, just a vast and empty space. Now behind you, unheard and unknown to you, a light is switched on—call it the sun. What would you see in front of you? Surprisingly perhaps, the answer is nothing! To your eyes the cosmos, although filled with light, would be as vast and empty, and as black, as before.

I once asked the Apollo astronaut Rusty Schweickart what it was like to look into the reaches of outer space. He told me that it was not so easy to do, even while space walking, because the accompanying hardware of space exploration constantly and brilliantly shone in the light of the sun. Yet if all that was behind him then, yes, the light-filled space about him presented itself as a darkness dusted with stars.

It has always struck me as quite wonderful that our experience of darkness is not dispelled by light alone, not even by the intense light of the sun. Light itself is invisible and so left to itself can provide no sensation of light. Something else is required if we would have a luminous world. Our experience of light requires substance. Vaporous or dense, substance catches the light and then displays the substantial world of objects to our sight. Darkness is not merely the absence of light, but equally the absence of substance. Our experience of light requires both.

One of the most delicate substances to play with the sun's light is the atmosphere of the earth. Nearly invisible in itself, it nonetheless is the medium for rainbows, auroral displays, lightning, the blue sky, and sunsets. In these phenomena we can gradually learn to discern a relatedness, a whole that gives to the earth a shining aura of color along with its sheath of air.

The darkness of the night sky does not press in upon us but draws us out into itself. It is said of the mystery religions in northern Europe that twelve helpers assisted the aspiring neophyte during initiation in order that his experience of the macrocosm would not overpower him. The cosmos threatened to dissolve his "self" as a drop is lost in the ocean. Standing on a high mesa in Arizona with the night sky above me I can believe that to be true.

Yet the vertigo of night is offset by the fixed patterns of stars that seem to be anchor points in the void. Their clarity and unerring regularity of motion made them the birthplace of science. Babylonian priests atop ziggurats or stepped pyramids studied the stars for calendar information as well as for omens of the future. In these priests one discerns both the hoary mythic and the infant scientific consciousness in a transient coexistence. We, each of us, live between these two poles of mystery and scientific clarity. The tension between them has animated many poets and scientists. Thoreau was one who lived this tension, who as naturalist observed nature closely and learned from her, and as writer shared her mystery with others. While the eternal lawfulness of the stars interested him less than "the unhandselled wilderness which the forest is," still he "pined for a new world in the heavens as well as on earth." In approaching the lights and colors of the sky I would like to remain sensitive to Thoreau's longing, one that I think many students of nature share. The phenomena of the sky are beautiful and delicate, and there is much poetry within them. It may seem to be a poetry that eludes the lens of science, but in reality it merely eludes that mind that can only see the heavens through the eyepiece of a telescope.

We can begin our considerations of the sky and the transformation of darkness into color with an observation by Thoreau himself.

## Between Darkness and Light

The night sky is rarely truly black, changing with even the slightest illumination to a deep "midnight" blue. In his journal entry for January 21, 1853, Thoreau wonders at the blueness of the sky by night.

> *The blueness of the sky at night—the color it wears by day—is an everlasting surprise to me, suggesting the constant presence and prevalence of light in the firmament, that we see through the veil of night to the constant blue, as by day. The night is not black when the air is clear, but blue still. The great ocean of light and ether is unaffected by our partial night. Night is not universal. At midnight I see into the universal day. Walking at that hour, unless it is cloudy, still the blue sky o'erarches me.*

Thoreau was right; the presence of light in the firmament, within the air above us, gives rise to the blue sky by night as by day. How is it that the dark night sky is changed to blue? The airless sky of the sunlit moon remains forever black. On the earth it is the mantle of the atmosphere, the air we breathe, that provides a medium many miles in depth with which sunlight interacts to produce the blue of the heavens. Moreover it is just that light that reaches us indirectly (Mie-scattered, in the language of physics) that is responsible. We can notice that the blue nearest the sun is paler than that at a distance. Thus is the black void of space transformed to blue through a particular interplay of substance and light.

Nor can just any substance act as the substratum for a blue sky. For example, when water vapor in the air condenses into droplets, white clouds appear. As the size of the droplets becomes larger than the wavelength of visible light, the way in which the droplets interact with sunlight changes. Whereas the finest substances of our atmosphere transform the white light of the sun into the blue of the heavens and the red of the sunset, the larger cloud droplets, like millions of minute mirrors, reflect to us an untransformed color image of the sun. The shape of the sun is lost, but its color, or "spectral image," is essentially preserved in the color of the cloud.

Nor will just any arrangement of sun and air yield blue. As the sun approaches the horizon the blue of the sky above deepens, while the sun itself, together with the sky and clouds around it, becomes yellow, then orange, and finally even a fiery red. If we look at the source of light, the warm, sunset colors arise; if we look away, then the cool blues and violets of the evening vault are seen. If in addition clouds are overhead they will, once again, reflect the spectral image of the sun, now red on the horizon.

For the German poet and naturalist Goethe, the phenomena of sunset and blue sky were "archetypal" instances. In them one could learn to see the essential relationship between light, darkness, and substance that gives rise to color, whether in the sky or through a prism. "The blue of the heavens reveals to us the fundamental law of chromatics. One should only not seek anything behind the phenomena; they themselves are the theory."

Looking east at dawn and west at dusk, we witness the twilight transition between day and night. On clear evenings the sunset colors seem to form a broad, shallow rainbow; deep red nearest the sun at the horizon, orange and yellow slightly farther up. The dark indigo overhead lightens to blue as it reaches down towards the yellow. Only green is missing (although sometimes I fancy I see it hovering at the edge of visibility where the blue and yellow join). As I watch such a sunset, I am mindful of the sunrise continents away that mirrors my evening experience.

Thus a great circle of twilight circumscribes the earth: sunrise on the one side, sunset on the other. The earth turns within its twilight circle of color, the plane of which is perpendicular to the earth-sun axis. This circle marks the boundary between light and darkness where the radiant colors of daybreak and dusk fill the heavens. As dawn races incessantly westward, one hears in imagination the sounds that follow the new light, the sounds of birds and people and life.

It is against this background of light and darkness, or the blue sky and twilight colors, that I would like to discuss the rainbow, lightning, and the aurora. Individually each has its own special character; taken together we will see their complementary nature and place in the earth's many-colored mantle.

## The Rainbow

The spectral arc of the heavens we call the rainbow incites our imagination as it did that of our ancestors. It has been a source of wonder, myth, and superstition for millennia, but it has also been a phenomenon pregnant with implications for the study of optics and is thus a fine demonstration of the evolution of scientific thinking.

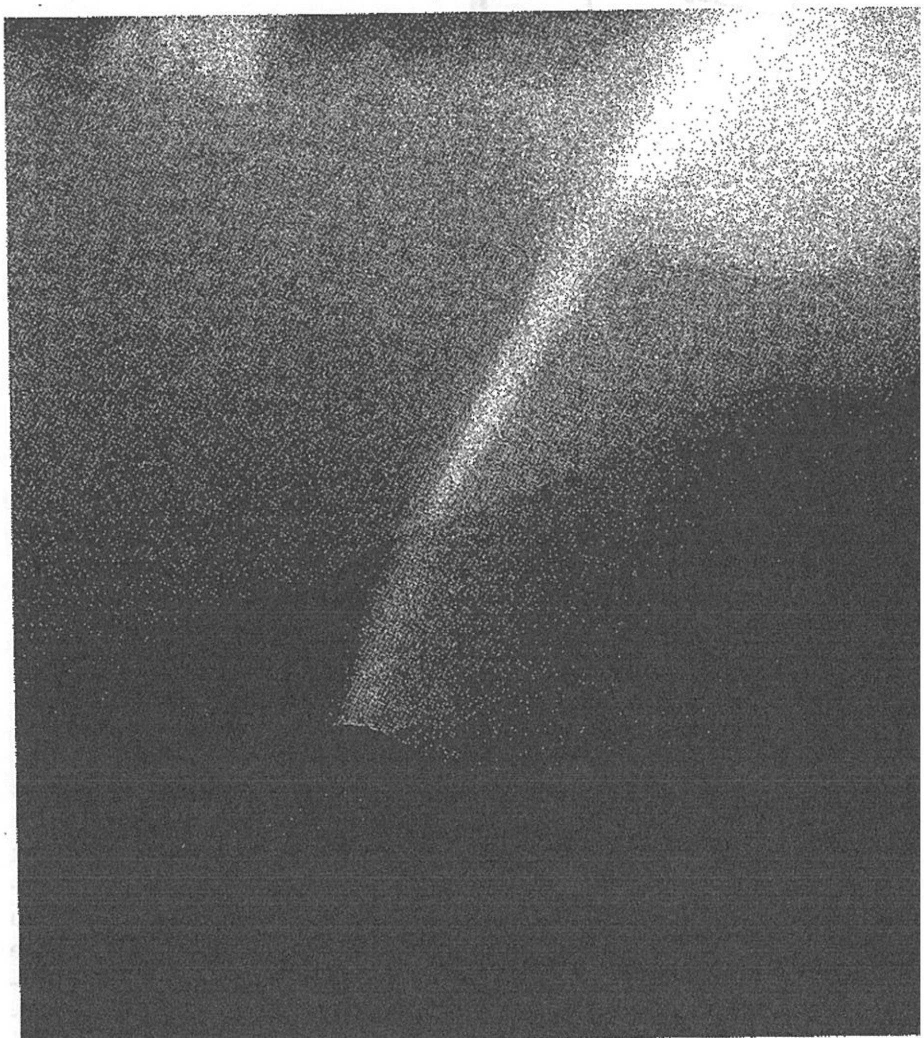
For Homer the rainbow was an image of the goddess Iris. Thus his account of her origins is also an account of the rainbow. Thaumas, the god of wonder, "chose Electra for his spouse/of the deep-flowing Oceanus child;/She bore swift Iris, fair-haired harpies too." Iris, the rainbow and messenger of the gods, unites Oceanus, the deep-flowing, outer sea that encircled the ancient world, and the mood of wonder. *Thauma* was the Greek word meaning miracle. The encircling waters of the world are associated in the Greek mind with the miracle of the rainbow. As Plato wrote: "He was a good genealogist who made Iris the daughter of Thaumas."

In their flood stories the Semitic people of the Near East place the genesis of the rainbow at the end of the deluge. The biblical Genesis also connects the first appearance of the rainbow to the deluge and covenant established between Jahve and "all flesh that is upon the earth." In the Sumerian myth of the flood it was called "the arc which draws nigh to man, the bow of the deluge."

The arc of colors that reaches from heaven to earth became quite naturally a bridge that connects two worlds. In the Edda when Odin is asked the way from heaven to earth, he "answered and laughed aloud: 'Has it not been told thee that the gods made a bridge from earth to heaven, called Bifrost? Thou must have seen it; it may be that ye call it rainbow.'" For the North American Indians, Polynesians, and others, it was a pathway for souls to the upper world; in Japan the "floating bridge of heaven"; and so on around the world. Its mystery continues to enchant. Approach it and it recedes so you can never walk beneath its arch, nor greet the leprechaun atop the pot of gold at its end.

Our view of the rainbow began to change from the mythic to the scientific during the Greek period. Already we find an impressive treatment by Aristotle in his *Meteorology*, where it is considered a sublunar "meteor" of light together with halos, the aurora, comets, and meteorites. His observational account is remarkable for its clarity and is the first to consider carefully the geometrical and physical basis for the rainbow.

Each of us, like Aristotle, has seen rainbows, but our observations, unlike his, are careless and unorganized. By simply studying the rainbow's appearance a wonderful lawfulness shows itself, one



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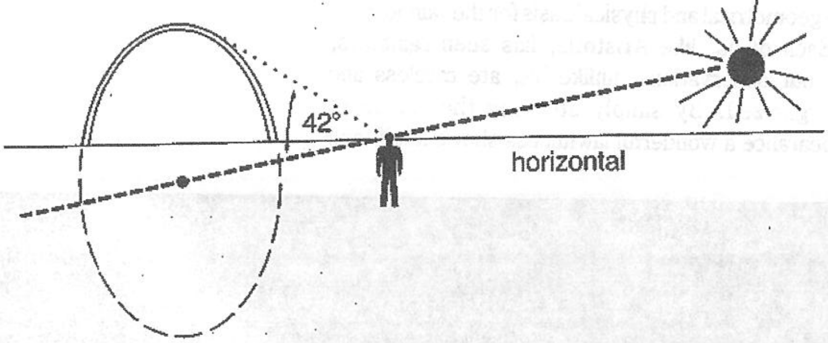
that weaves together light, darkness, and the element of water.

Where, when, and under what circumstances do rainbows appear? Two elements are required: sunlight and rain. The sky is usually partly darkened by clouds; a rain may have just passed overhead, and the sun, now low on the horizon, throws up an arc of color opposite it. The shape of the bow is a segment of a circle. The geometry of the rainbow is very precise. Its time of appearance is evening or morning; its orientation to the eastern or western horizon. Unlike lightning and the aurora, it reflects an extraordinary spatial and temporal order.

The colors arrange themselves in an invariant sequence in the primary bow; from the inside out they are blue, green, yellow, orange, and red. The placement of the colors is exact. Draw a line from the sun through the observing eye, and a second from the eye




to the rainbow, and the angle formed between them is always forty-two degrees, whether the rainbow is in a spring shower or in the mist of a garden hose. A careful observer will notice several other aspects. First, the rainbow appears between a light-filled interior space and a dark exterior band—Alexander's dark band. Once again colors arise between light and dark; Goethe must have been pleased with this observation. I called the dark exterior a band because just at its outer edge a fainter, "secondary" rainbow often appears, again at a precise angle, now fifty-one degrees. The colors of the secondary bow are inverted, with red on the interior and blue outside. This perversion of the color sequence gave rise to the widespread belief that the secondary bow was the handiwork of Satan, created as a parody of the Lord's covenant with Noah. In Germany and Arabia it was called "the devil's rainbow."

To determine where a rainbow may appear requires knowledge of the line connecting eye and sun. It is the axis of reference running essentially east-west through eye and sun, and around which both the primary and secondary bow circle. But what if two observers stand next to one another—do they see the same bow? No. Each has his own, unique experience of the rainbow because each has a unique eye-sun axis. As a young man the poet Gerard Manley Hopkins in 1864 puzzled on the rainbow and its observation. How is it that we can see a rainbow? It is not painted in the air like the painted side of a house but seems created by light, water, eye, and mind.

*It was a hard thing to undo this knot.*
*The rainbow shines, but only in the thought*
*Of him that looks. Yet not in that alone,*
*For who makes rainbows by invention?*
*And many standing round a waterfall*
*See one bow each, yet not the same to all,*
*But each a hand's breadth further than the next.*
*The sun on falling water writes the text*
*Which yet is in the eye or in the thought.*
*It was a hard thing to undo this knot.*

One final aspect of the rainbow phenomenon is the so-called supernumerary arcs. These are ephemeral arcs of alternating pink and green that sometimes appear just below the primary bow. Look for them in the next rainbow you see; they are often missed, but their graceful beauty rewards the attentive observer.

The history of the theory of the rainbow runs from Aristotle through Grosseteste, Descartes, Newton, and the modern wave theorists. New concepts of optics either arose from careful study of it or were quickly applied to it in order to explain its mysterious features. Descartes used a large, spherical glass vial of water to show how Alexander's dark band arose as well as how the laws of refraction and reflection yielded the angles forty-two and fifty-one degrees for the primary and secondary bows. Newton invoked his theory of "diverse refrangibility," and gave an account that assigned to each color of the rainbow its own angle of appearance, while Thomas Young proposed that wave interference might account for supernumerary arcs.

Yet our detailed theoretical understanding only affirms the grandeur of the phenomenon. Once we learn to perceive the extraordinary and detailed order of the rainbow, the laws of optics there embodied become matters not of abstract explanation but of experience. Scientific observation can re-enliven our experience of the world if we remain attentive to the pattern of the phenomena around us, and do not replace what we see with physical theory.

Until the seventeenth century in France, the rainbow was known primarily as *iris* in honor of the Greek messenger goddess. René Descartes replaced the name with a more prosaic and until then seldom-used phrase: *arc-en-ciel*, "arc-in-the-sky." The transition from the mythic to the scientific reflects itself in the evolution of language.

Yet Iris still reigns in one part of our universe. Consider once more the line passing from the sun through the pupil of the observing eye. When that line is extended out to sunlit mists, a rainbow appears encircling, like Oceanus, that axis of sight. But another far more modest ring of color encircles that same axis. It rests upon the aqueous organ of vision itself, between a black interior and a white exterior, and carries still the name of Iris—messenger of the gods.

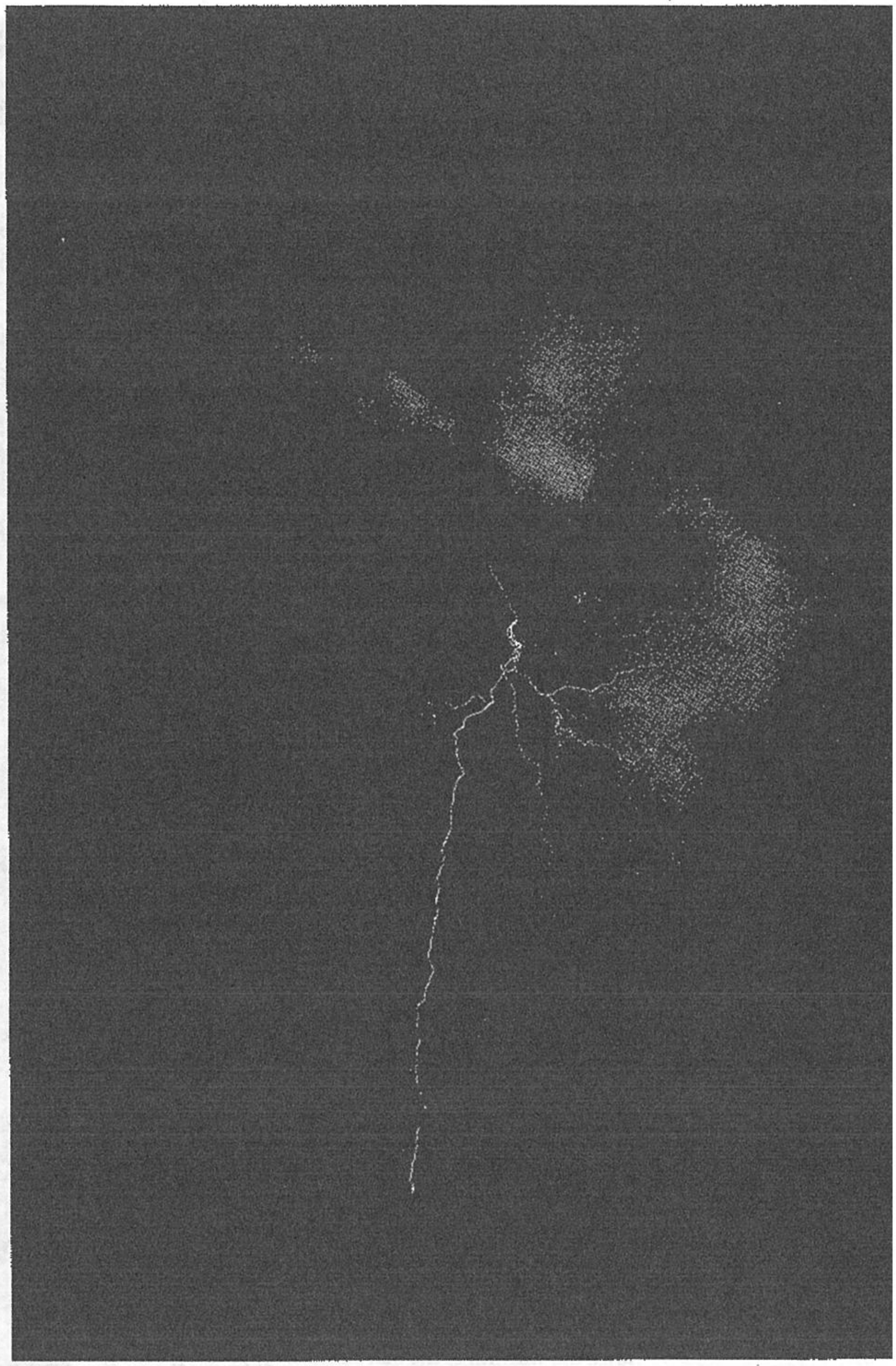
### Lightning and the Aurora

Within the National Museum at Athens there is a small and ancient statue of Zeus. Much like the larger and magnificent Poseidon of Artemision a few rooms away, he raises his right arm for throwing and his left is outstretched before him in graceful balance. In place of Poseidon's long trident, however, Zeus brandishes a stubby, pointed object at first not easily recognizable. That same stubby object is found in Zeus's right hand in museum statuary around the world. While unlike our contemporary comic-strip image of lightning, it is unambiguously the thunderbolt of Zeus, his infamous weapon. Father of the gods and men, god of the sky and weather, Zeus wielded his thunderbolts, forged by his smiths the Cyclopes, in his revolt against the Titans and in separating the battling Hercules and Apollo. The power and drama of a thunderstorm fit well in our imagination with the warring Titans or Apollo and Hercules. How different the silent, distant, eerie, and gently luminous aurora. Both lighting and the aurora have, like the rainbow, stirred the imagination. In the many-hued cloak of the atmosphere, these two stand like poles, with the rainbow balanced between them.

Towering thunderheads, driven by powerful updrafts, darken the afternoon summer sky, giving perhaps an unearthly yellow-gray color to the heavens. The wind blows, and an inner tension fills the air. Rumbling first in the distance and then gradually closer, the storm approaches until quite suddenly the winds gust briefly, the rain falls earthward, and the sharp, fissurelike forms of lightning strike nearby to be followed by the rattling crack of thunder. As the storm moves, one may be surrounded by bolts of lightning abruptly and capriciously arcing across the sky or from cloud to earth. We can be frightened by the power, speed, and unpredictability of lightning.

The aurora stands in complete contrast to lightning. The wintry night sky does not threaten but is clear and tranquil during auroral displays. The hush and expectancy contrast strongly with the intimidating and crackling tempest of a thunderstorm. Instead of the jagged, fissurelike forms of lightning, veils of gentle, mobile, delicately radiant color seem to hang high in the heavens. Auroral displays can last for many hours and possess a wonderful temporal and spatial morphology of their own.

Lightning and aurora both have special signatures that reveal themselves in every detail.



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The classic thunderhead or cumulonimbus reflects in its form the powerful forces that generate it. With its base at an altitude of two or three thousand feet, its anvil-shaped head may rise as high as ten or fifteen miles where the supercooled vapor changes into crystals of ice. Within the heart of the thunderhead, electrical processes are at work separating charges in ways still not completely understood. The consequence of that action, however, is very clear. An enormous electrical tension is introduced within the cloud and, through a kind of mirroring process, also induced within the earth. The tension builds until the air is rent by the flash of lightning.

Lightning can arc from one location within a cloud to another, from cloud to cloud, from cloud to earth, or even upward into the clear sky above the storm. Each of these paths will image itself to us on the earth in its own way. For example, "sheet lightning" is likely to be an intracloud flash where the lightning stroke itself is hidden by intervening clouds. Except for the extraordinary and little understood phenomenon of "ball lightning," all lightning can be understood as instances, variously transformed, of the archetypal ground flash. As we study it more closely, we discern a characteristic temporal and spatial development that manifests itself again and again at various scales.

A complete lightning discharge—termed a flash—typically lasts only one-third of a second. It in turn is generally comprised of several "strokes" (up to twenty-six strokes have been recorded in one flash) each lasting a mere one-hundredth of a second. The rapid pulsing of lightning that we sometimes see is not an illusion, it is a fact. These erratic hammer strokes of light that seem to pound the earth are preceded by a faint, luminous electrical action that escapes normal observation and is called the "leader process." Prior to a lightning flash, a "stepped leader" is sent down from the cloud. It is a thin channel formed by an electrical surge that travels in fifty-meter steps, pausing and going on, forging an irregular path that eventually (after only two-hundredths of a second) reaches from the cloud to within fifty meters of the earth. The electric potential of the leader channel with respect to the ground is about ten million volts. A "streamer" rises to meet it from the earth, completing the electrical link. Then, the visible, even blinding return stroke travels *up* the channel created by the leader at the tremendous speed of about fifty thousand miles per second. Prior to each subsequent stroke, a "dart leader" passes unnoticed to the earth along the old channel, to be followed by a brilliant return stroke once again.

An arhythmic pounding forges a tortuous channel made visible in a brief series of powerful electrical discharges that relieve the electric tension built up by the storm. Every few thousandths of a second another abrupt transition occurs in the development of the flash. Finally sound joins the drama of light in an explosive thunderclap that rumbles off into the distance.

Thunderclaps, heard up to twenty miles away, are noted by weather stations around the world. The number of "thunderdays" thus tabulated (days during which thunder was heard) varies from zero in far northern and southern polar latitudes to almost every summer day near the equator. Using the versatile photographic capabilities of satellites one can now image at least the strongest flashes from space and likewise notice their geographic distribution. From these data one recognizes as well a pronounced predominance near the equator and expected absence of lightning near the poles where rainstorms rarely or never take place. One also notes from such satellite maps that lightning storms cluster over landforms, seldom occurring over the open sea, forming thereby an elaborate flashing tracery over the mid- and equatorial latitudes.

Fifty thousand thunderstorms occur each day, but their distribution is by no means uniform or static. A rhythmic, periodic development exists both on a daily and annual time scale. While exceptions exist, weather research shows there is a clear daily maximum of thunderstorms during the hottest part of the day between two and four p.m. Similarly, thunderstorm activity follows the warmth of the sun seasonally, peaking during the summer months. The tracery of global lightning swings north during June through August, and down to the southern hemisphere six months later. Like the circle of twilight or the arc of the rainbow but much more erratic, there is a very real arc of lightning that moves westward in the mid-latitudes following the afternoon sun on its journey around the earth. Through the facts of lightning one builds up an image not only of the single flash but also of the global pattern of lightning in our atmosphere.

By their very names the aurora borealis and aurora australis, the "northern and southern dawns" respectively, contrast with the geographical distribution characteristic of lightning. Northern lights and their analogous southern cousins do indeed normally occur

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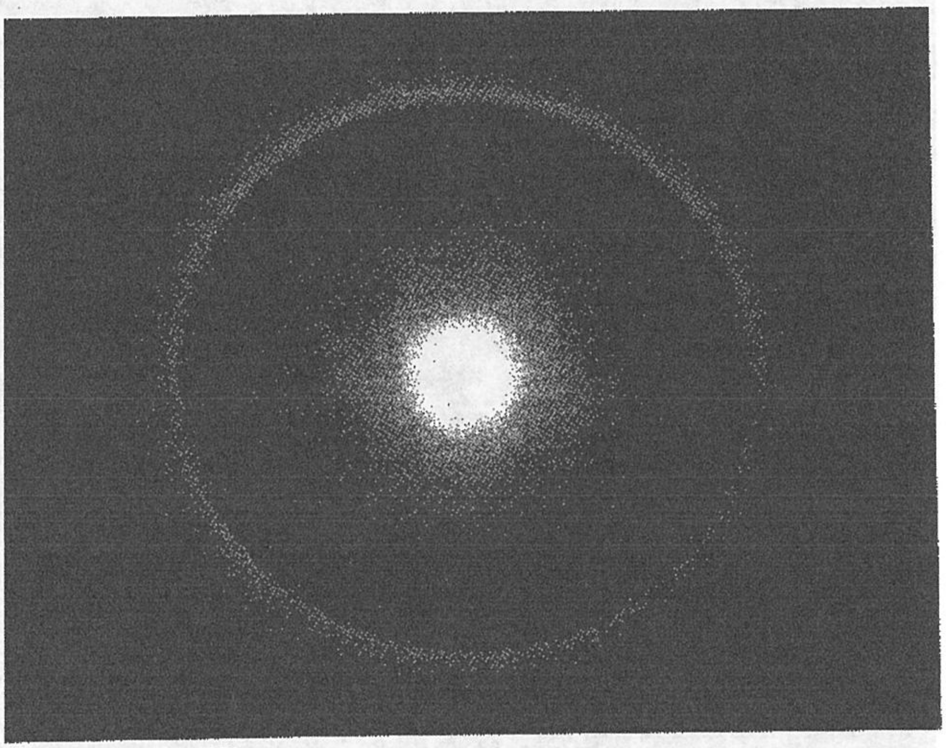
near the magnetic poles, reflecting in their global distribution the remarkable interworking of solar emanations with the earth's magnetic field. In their forms, manner of appearance, development in time, and much else, the aurora contrasts with lightning.

While the possibilities are infinite, an aurora might develop in something like the following way. The night is moonless, dark, cold, and clear. At first one might see a simple, broad white arc in the northern sky with a smooth lower edge, its ends never touching the earth. The lower border may then develop folds and kinks, the colors turning to yellow-green or red. The once tranquil arc now shows a pulsing and less regular light form. The forms, structures, colors, brightness, and temporal behavior can each be classified in the language of the auroral scientist. Auroral displays often intensify over time, passing from a relatively tranquil, homogeneous display to more elaborate, vibrant forms sometimes culminating in the so-called corona, a magnificent rayed form whose auroral light streams out from a common center high overhead.



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Although the Eskimo will say the aurora makes a swishing sound as it touches the ground, no scientist or naturalist has heard the northern lights nor seen them dip closer than fifty miles above the earth's surface. They move and glow hundreds of miles above us in the most tenuous parts of our planet's atmosphere, right up to the stratosphere a thousand miles above. By contrast, lightning, loud and violent, is confined to the thin ten-mile layer nearest the earth's surface, the troposphere.

Auroral displays were certainly known in antiquity. Aristotle reports the appearance of "chasms, trenches and blood red colors" in the night sky. Later Plutarch repeated the report of an earlier fifth-century B.C. aurora visible for seventy-five nights. Sightings like these in the Mediterranean were extremely rare, but in the far north (or south) there were and are regions where an auroral display can be seen every clear dark night. The experience of these beautiful phenomena led to a rich lore concerning the aurora among the indigenous peoples of the north.

The spiritual traditions associated with the aurora are relatively homogeneous. Among the Eskimos the aurora is connected with departed souls. Those who have died a voluntary or violent death cross a narrow and dangerous bridge and enter heaven through a hole. Here they play ball, and their game is seen below as the aurora. The Eskimo word for the aurora is *aksanirg* meaning "ball-player." The Eskimo of northern Canada called the aurora the "dance of the dead," while in Greenland stillborn or premature children play ball in the heavens after their untimely death and so give rise to the aurora.

The aurora also appears in legends and stories of northern Europe. In the Finnish tale of *Repu*, the aurora is a fox's tail that flashes fire but not heat. The modern Finnish word for aurora is, in fact, *revontuli* meaning fox fire. In other stories it is the reflection of the silver herring run or the blow-off of a mighty whale caught fire.

As a prognosticator, unusually dramatic displays are almost universally taken as omens of war and disaster. Such views have persisted right up into modern times, for instance in the interpretation of the Miracle of Our Lady of Fatima, when the Virgin appeared to three shepherd children on May 13, 1917, telling them "when you will see a night illuminated by an unknown light, know that this is the great sign that God gives you that the chastisement of the world is at hand." Another instance of the connection between the aurora and disaster is to be seen in the unusual auroral display during the night of January 25, 1938, which was taken to foretell Hitler's invasion of Austria three months later.

In northern Lapland, legend and science make contact. There the aurora is seen as the winter analogue of summer's thunderstorms, both being a mixture of fire and water. The inverse seasonal correlation between the aurora and thunderstorms was also reported by Smyth of Edinburgh's Royal Observatory in 1878. That relationship bespeaks a common origin. Both thunderstorms and the aurora reflect aspects of the sun's activity. The growth of a thunderstorm is ultimately due to the heating action of sunlight as it falls upon the earth. Thus while there are many complicating circumstances, thunderstorms are associated with the warmer seasons of our year and with the afternoon hours. The heat of the sun provides the energy for the dynamics of the thundercloud and also for lightning.

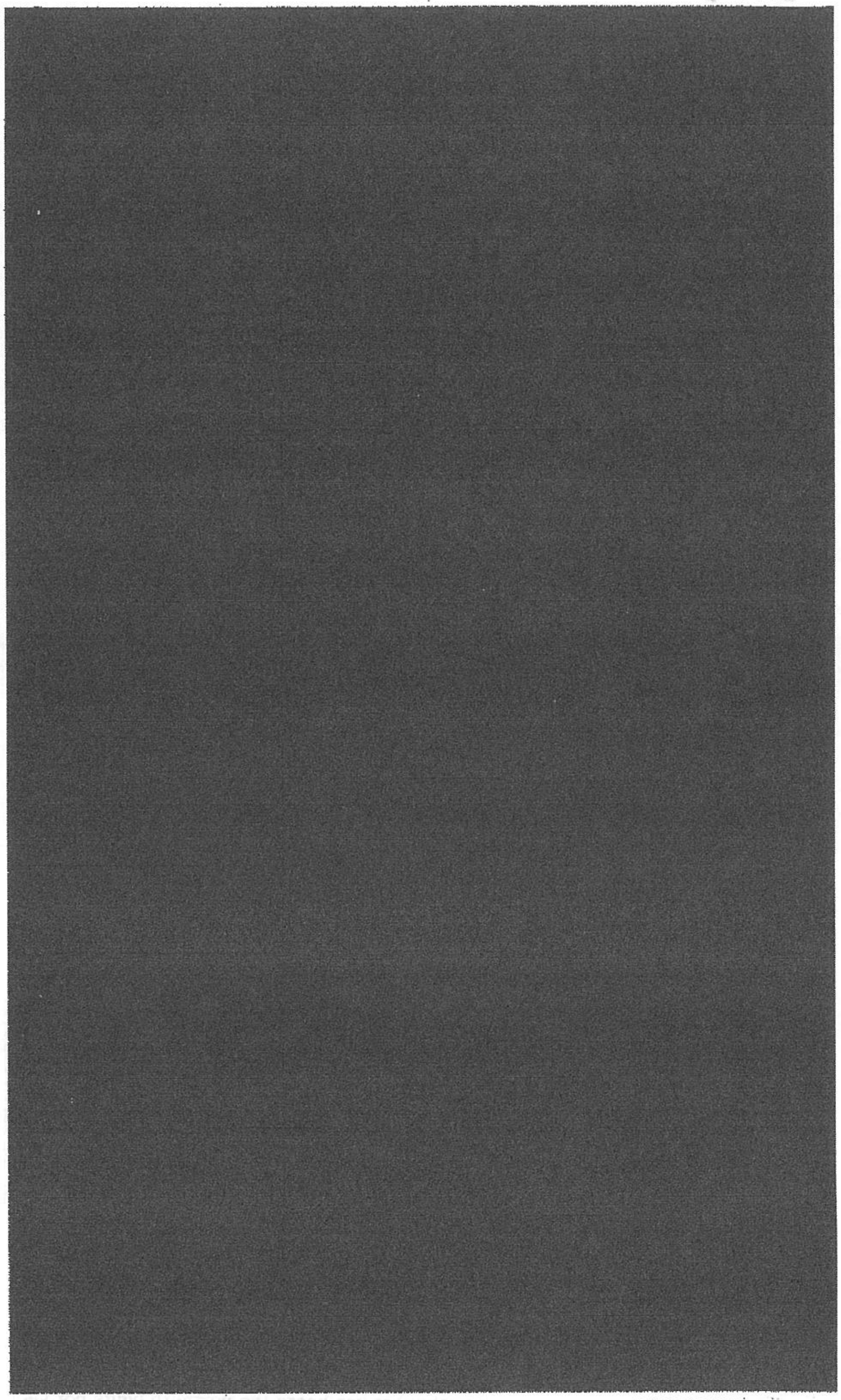
By contrast, sunlight would only obscure the aurora. Rather than the warmth of the sun, it is the "dark" solar wind comprised of energetic charged particles that is responsible for the aurora. Constantly, but particularly following solar flares, great clouds of electrically charged substance stream outward from the sun and after two days of travel reach the earth. Before penetrating the atmosphere, however, they are guided by the earth's magnetic field toward the poles, and by a complex interaction with the magnetosphere, primarily to the night side of the earth. Streaming into the earth's sheath of air, these energetic emanations from the sun interact with nitrogen and oxygen in the atmosphere to light up the heavens via processes very like those at work in a neon sign. Their interaction with the earth's magnetic field forms the global auroral distribution into an enormous oval of shimmering color at roughly sixty-seven degrees magnetic latitude. This auroral oval that rings the magnetic poles was first inferred by Sophus Tromholt in 1881 from ground-based observations but can now be verified beautifully in images of earth taken from space. Thus another "oceanus" rings the earth, this one around the magnetic poles north and south.

The aurora is a silent, wonderfully mobile phenomenon of the polar night that images to us the interaction of charged solar substance with the earth's magnetic fields all made visible within the tenuous upper atmosphere of our planet. Once again the atmosphere acts as the medium in which solar and telluric forces interweave to bring forth an experience of light.

There are many lights within the earth's richly colored mantle of air. Others worthy of our attention would be the glory or "spectre of Brocken," the corona, and halos around the moon and sun. But I hope that from the few described one can gain an appreciation for the manifestations of light, darkness, and substance in their manifold interworkings.

Each phenomenon—whether the blue sky, sunset, rainbow, lightning, or aurora—carries with it its own distinctive signature. Taken together, they form a glowing tapestry of lights embracing our planetary home. The aurora glows about the polar regions, while lightning flashes nearer the equator. The rainbow, associated with the rising and setting sun, is to be seen in west or east, at dawn and dusk. The afternoon, summer thunderstorm contrasts with the wintry aurora of night. Thus in all directions of the compass, in all seasons, and throughout all hours of the day and night, the air we breathe plays host to luminous phenomena that reflect an ever-changing but lawful relationship between earth and sun, one that brings light and color to our lives.

The seasons in their color and fragrance, the foliage fresh in its spring and brilliant in its autumnal colors, the blossoms of early spring flowers and the fruits of autumn, all draw us into the rhythms of the year. While such terrestrial patterns of nature impress themselves on us, a subtler yet larger metamorphosis parallels the changes beneath our feet and close at hand. If we look up, another range of phenomena meets us: the lights and colors of the heavens. They too token an organism. In their diversity we can learn to see a whole, articulate in time, and spread throughout space. As such the lights and colors of our earthly sky become another aspect of the earth as organism, another face of Gaia. ●



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