

Finding Inspiration in the Face of Endangered Starry Skies

C. A. Moore¹

A. M. Richman²

V. D. Chamberlain³

Abstract. A common axiom states that the starry sky as seen under excellent viewing conditions has been one of the most inspirational sights in all of human history. It is also apparent that a decreasing percentage of humanity experiences that inspiration today. Thus, at the very time when science has the ability to educate the most about the vast universe, it is theorized more individuals are less connected with the cosmos than ever before.

1. Introduction

One of the most inspiring of human experiences is standing under a dark, crystal clear, night sky ablaze with stars; surely the earliest human minds would have been amazed by it. Today, it appears that fewer and fewer people find a connection to the cosmos. Despite the wealth of accessible astronomical knowledge today's technology has brought us, sources of inspiration that drive human curiosity and imagination toward an understanding of the cosmos are diminishing. The causes of this diminution of inspiration are many, including skyglow and atmospheric pollution as well as contemporary lifestyles of an urban populace. This decoupling of knowledge and inspiration is a recent development and may have far-reaching impacts. We have inherited a long lineage of astronomical knowledge that was nurtured by Galileo and has matured into our wealth of instruments that harvest detailed information about our cosmic environment. Such knowledge is passed down through the ages, but inspiration is not inherited in the same manner.

1.1. Night Sky as a source of inspiration for the humanities

For many, astronomy is not a study of physics and stars, but a study of where we are in the universe, where we came from, and what lies beyond our reach. Readily visible, but not directly tangible, the night sky as revealed by a transparent

¹Night Sky Program, Air Resources Division, National Park Service, CSU-CIRA, #1375, Fort Collins, CO 80523, USA

²Office of Interpretation and Education, Intermountain Region, National Park Service, 12795 W. Alameda Pkwy, Lakewood, CO 80228, USA

³Astronomer-retired, 1021 Country Club Dr, Kanab, UT, 84741, USA

atmosphere has illuminated the humanities. Both the intellectual and emotional aspects of the stars have equally touched the human journey. For example, the signature line in Walt Whitman's (1819-1892) *Leaves of Grass* encapsulates one of the great revelations of modern astrophysics:

I believe a leaf of grass is no less than the journey-work of the stars.

And philosophers have expounded upon the inspiration of the star swept sky. Inscribed on his gravestone, Immanuel Kant (1724-1804) affirmed,

Two things fill my mind with ever increasing wonder and awe, the more often and more intensely reflection dwells on them—the starry heavens above, and the moral law within me.

Even Plato (circa 429-347 B.C.) waxed eloquent on the topic:

Astronomy compels the soul to look upward and leads us from this world to another.

Indeed, wordsmiths of all types and persuasions have attempted to express the exhilaration, yet illusiveness, of the looking-into-the-night experience. British writer Llewelyn Powys (1884-1939), who has been called a philosophical poet, gave us what might be the finest expression of inspiration from the visible heavens in his 1931 *Impassioned Clay*:

No sight that human eyes can look upon is more provocative of awe than is the night sky scattered thick with stars.

Still, none of these quotes quite do justice to the cosmic encounter, that first-hand experience of seeing the starry sky for oneself. Our search for introspection amidst what we see overhead must have started when the first human eyes looked up at night, and this age-old quest continues up to the present, but for many the inspiration derived from this search is in jeopardy.

1.2. Night Sky as a touchstone for science

This science of astronomy explores the vistas of the sky using the basic disciplines of physics and chemistry, with the empowerment of mathematics, to weave an intellectual fabric describing space. Many scientists have paused in their technical discourse to express the roots of their inspiration in terms intended for everyone. Jean Perrin (1870-1942), the 1926 Nobel Prize winner in physics, did so in the form of a question:

It is a feeble light that comes to us from the stars, but without it what would be the present condition of Mans mind?

French mathematician and theoretical physicist Henri Poincaré (1854-1912) stated,

Astronomy is useful because it raises us above ourselves; it is useful because it is grand; It shows us how small is mans body, how great his mind. His intelligence can embrace the whole of this dazzling immensity, in which his body is only an obscure point, and enjoy its silent harmony. Thus we attain self insight, something which cannot cost too dear, since this insight makes us great.

Isaac Azimov (1941) probed a similar hypothesis by means of imaginative literature when he wrote *Nightfall*, a science fiction short story taking place on the planet of Lagash, a world surrounded by six suns, within the swarm of stars of a globular cluster. This world was bathed in light, but a rare alignment every 2049 years plunged the civilization into darkness. Lagash society bears a resemblance to ours today but differs in some important ways. Despite having advanced medicine, it lacked comprehension of gravitation. The people of Lagash had technical prowess, but cult beliefs and superstition squelched the advancement of and respect for science. When darkness came, the stars appeared more brilliant than from our vantage in the Milky Way Galaxy. Such instantaneous self-awareness tore the fabric of Lagash society, and the civilization collapsed in fear and violence.

By the good fortune of Earth having a transparent atmosphere, human knowledge has evolved to present levels and has done so alongside greater insight. Azimov hinted that these two maturities must develop together, lest we face catastrophic results. When science stares deep into space, it sees the vastness of the universe. When humans look upward into the night sky, we often reflect inward.

The NASA space program has left us with many indelible images and moments, but perhaps the most recognized photograph ever captured was one from Apollo 8 of the gibbous Earth rising over the lunar surface (Life 2005). Surprisingly, the photographer astronaut William Anders, took the image spontaneously, it was never part of the mission plan (PBS 2005). The image has come to symbolize the exploration of our final frontier as well as the fragility of our planet; interestingly, it does not look outward, it looks back. This human journey for such perspective is often our greatest source of inspiration.

Consider the list of individuals, from Thales to Galileo to Hubble, who were inspired by the starry canvas and, in turn, have inspired all humanity following them. We will now draw upon the experience of those in the planetarium field, in public interpretation of the night sky in parks, and those who document the diminishing darkness by field reconnaissance, to discuss sources and modes of inspiration. Let us evaluate two venues where the mind can be engaged by astronomy and eyes can look upon a starry sky.

2. Planetariums

Along with the development of astronomical instruments intended for exploration has come planetarium technology designed to interpret and visualize what was being learned. About 300 B.C., a conceptual model of the universe, the *Atlante Farnesiano* held atop the shoulders of the kneeling Atlas, presented a visual concept of the heavens—a celestial sphere with constellations outlined—a gods eye view of the cosmos. The desire to model the universe was, it is said, presented by Archimedes in a “miniature representation of the vast vault of heaven...a globe which could be rotated so that the seven wanderers went through various and divergent movements with their different rates of speed.” (see King 1968, p. 17)

Eventually celestial modeling evolved nearer to what we actually see from our earthbound vantage. In 1654 A.D., Adam Olearius (or Olschläger), court mathematician, librarian, and astronomer to Duke Frederick of Holstein-Gottorp,

completed a 3.1 meter diameter hollow copper globe into which visitors could enter through an opening in the lower section. This Gottrop Globe rotated about an inclined axis so that audiences could admire painted constellations with gilt stars rising, gliding, and setting. Glass balls, representing the Sun and Moon could be moved along the zodiac; a small Earth globe stood in the center (see King 1978, p. 104).

A century later, a small yet significant planetarium innovation was added. In 1758 Roger Long, Lowndes' professor of astronomy in Cambridge, England, created an 18 foot diameter globe inside which 30 people could sit on a platform while the globe revolved around them so that they could observe stellar patterns. Stars more closely resembled those in the sky, being produced by holes pierced into the globe, with external lighting (see King 1978, p. 176). For another century and a half this remained the mode of modeling the sky for the public.

The progress of planetarium technology soon quickened. The projection planetarium had its origins in Germany, when the Deutsches Museum engaged the Zeiss optical company to make a grand model of the cosmos. In lieu of a very large celestial globe that rotated around audiences, engineer Walter Bauersfeld conceived a much simpler idea—instead of individual electric stars and planets attached to a bulky, and likely noisy, revolving theater, why not have a stationary dome-shaped screen beneath which projectors could cast images to simulate the heavens? Thus, in 1923, the Carl Zeiss Works demonstrated the first modern planetarium atop its own building, into which thousands paraded to enjoy this “Wonder of Jena” (King 1978). Other projection planetariums soon followed, and this invention spawned the new profession of planetarians, that of the interpretation of astronomical discovery for large numbers of people.

For eighty-seven years now, the planetarium profession has grown and evolved, along with the audiovisual technologies that support it. With modern digital projector technology it is possible to depict real astronomical data and seemingly transport audiences through deep time and vast space by means of stunning imagery. Humans originally intended the first planetariums to model the inner workings of the universe, essentially what could not be beheld by the naked eye at any given moment. Today's audiovisual technology enables impressive visualizations of the latest scientific discoveries; we have achieved the ultimate realization of sitting upon Atlas shoulders. For a growing number of people, planetariums have come to be a substitute for the real sky. What is becoming more stunning to many is not the revelations of the universe's inner workings but simply the reproduction of a natural starry sky.

One author would often follow his audiences out of the building after presenting the evening planetarium program. He observed that it was a rare person who would actually look up at the real night sky. Clearly the planetarium is effective at introducing millions to their first glimpse at the starry sky, but some have wondered to what extent planetariums provide significant cosmic perspective. Do such virtual displays yield lasting inspiration (Duriscoe 2001)?

3. The Worlds Finest Sky Theaters

Planetarians bring the stars down to millions of people each year, regardless of rain or sunshine, with visually stunning presentations condensing the latest

astronomical discoveries. Yet there is another effort engaged in a more powerful mode of bringing stars into the human equation. Within national parks and other places where large numbers of people travel to tune into what is beautiful and inspirational in the natural world, knowledgeable rangers experienced in interpreting natural science make presentations about what we see overhead. These sky interpreters resemble planetarians in their motivations and many of their methods, but they perform under the dome of the real cosmos. They provide an authentic, not virtual, experience, perhaps one where audiences are more apt to be inspired and see relevance to their lives.

The U.S. National Park Service was established in 1916 to protect places of natural beauty and national heritage that are rare and touch the soul (National Park Service Organic Act 1916). The sky above each national park has not always been considered a resource in need of preserving, but as park rangers have watched the lights of distant cities creep closer they have realized the starry night sky is worthy of protection and sharing with the public.

In the 1970s a subtle change took place as “night sky interpretation” was introduced into the U.S. National Park Service and elsewhere (Chamberlain 1976). Now, roughly 60 of the 392 units provide regular stargazing programs; for some it is a major educational activity. Bryce Canyon National Park, Utah, conducts over a hundred outdoor programs each year designed to share astronomical inspiration with visitors. In 2009 the park tallied nearly 27,000 astronomy-related visitor contacts (K. Poe, personal communication, October 10, 2009). Chaco Culture National Historical Park, New Mexico, has fewer visitors but has a good-sized observatory that is regularly used for introducing them to the vistas of the cosmos in the context of the ancient peoples who once inhabited the canyon. State and local parks are following suit. Cherry Springs State Park, Pennsylvania, has reoriented its program offerings to highlight the view of the night sky, partnering with amateur astronomers who become ambassadors of the night sky for the ensuing public (Bemus 2001). Attendance numbers at these park programs are poised to exceed that of some smaller planetariums.

In these places, people have an opportunity to gaze upon the natural night sky and see again what our ancestors experienced—they perceive for themselves that fundamental cosmic inspiration in the presence of skilled teachers. This is an experience made more precious by its rarity, and the increasing number of people seeking out these natural dark skies appears to be driven by the absence of a dark sky where most people live.

3.1. Documenting Night Sky Loss in Parks

Observation of the increasing impact of light pollution led to the formation of a program within the National Park Service to address the issue. Portable instrumentation was developed to measure sky brightness and document locations where dark natural skies remain. The program has found substantial degradation in most U.S. parks. Results show, under clear atmospheric conditions, light sources up to 300 km away are seen (Duriscoe, Luginbuhl & Moore 2007). Additionally, small degrees of light pollution noticeably alter the visual impression of the night sky (Bortle 2001; Moore 2001). Anecdotal interactions with the public and amateur astronomers indicate that an exceedingly small proportion have experienced a natural sky and that most have forgotten (or never knew) how

visually stunning the natural night sky can be. The survival of such dark skies is essential to combating “environmental generational amnesia” (Kahn 1999), and maintaining a touchstone of inspiration.

The onrush of light pollution led astronomer John Bortle to develop the nine-class Bortle Scale (Bortle 2001). This qualitative index sets Class 1 as pristine sky, only attainable with minimal air pollution and moderate natural airglow. At the opposite end of the scale, Class 9 represents an urban sky devoid of all but the brightest stars. The World Atlas of Artificial Night Brightness (Cinzano, Falchi, & Elvidge 2001) estimated two-thirds of the European and North American citizenry live in Class 6-9 areas, unable to see the Milky Way from their residences. Even the number of U.S. national parks regularly achieving Class 2 is limited to roughly 12 of the 76 surveyed to date.

If such outstanding sky quality as found in Class 1 and 2 is elusive to those with a predisposition to astronomy, it may be even more obscure to the general populace. Unfortunately, it is the last increment of darkness that reveals much of the wonder of the night sky (Moore 2001). Faint meteors that can be seen every few minutes, the long tails of comets, the spire of zodiacal light, the host of naked eye Messier objects, and the three-dimensional appearance of the Milky Way are all delicate features found in the realm of Class 1 and 2 and are not well duplicated by the planetariums of today.

4. Discussion

4.1. Inheritance of knowledge and inspiration

At the very time when scientists know most about the universe and the pace of discovery is accelerating, it is useful to question to what extent the public at large has participated in this knowledge. While many may argue that indeed more of the population understands simple astrophysics—that stars are fusion reactors feeding on hydrogen, that comets are dirty snowballs, and that our galaxy is one of many other cities of stars—it is our observation that the type of knowledge that makes the larger universe directly relevant is declining. A basic understanding of the phases and motion of the Moon, the ensuing tides, the tilt of Earth’s axis that causes seasons and changes the length of daylight, or what our galaxy looks like in the sky are less common now than before. Professional astronomers may believe such observational knowledge is anachronistic, but we suggest this is the type of understanding necessary to provide a bridge from their daily lives to the wealth of astronomical discovery. Today it appears transference of inspiration has been decoupled from transference of knowledge.

We can identify three key challenges for imparting astronomical inspiration. First is the challenge of the hurried urban lifestyle the majority of people now embrace. Most people remain indoors at night or have little time for contemplative moments under a celestial dome. Astronomers lack any control over this societal pattern, but there are other factors where they can exert influence.

Second, as education relies more on abstract teaching material, students are losing opportunities for first-hand, “eyes-on” experiences. Although remote imagery, such as the fantastic and beautiful images from the Hubble Space Telescope, has reached millions of people, such portrayals of the cosmos are dissected from the landscape of our lives. Natural learning opportunities that

are kept in situ are becoming rare, nearly completely overwhelmed by virtual experiences.

Third is the insidious problem of light pollution, which has driven starry skies far from where people live. In Galileo’s time, dark skies were common and telescopes were rare; four hundred years later, telescopes and the knowledge they produce have become common, and dark skies have become rare. This is a fundamental shift in the evolution of astronomy and the inspiration derived therefrom.

4.2. Right to Starlight

The concept of a “right to starlight” has recently been proposed (Starlight Initiative 2007). At face value, an obligatory right to see a particular astronomical object seems rather minor and absurd. However, when one considers the tremendous influence celestial observation has exerted upon the course of science and the repercussions those scientific discoveries have had upon the advancement of civilization and the collective human mind, stars are seen in a different light. By maintaining a right to starlight, opportunities for scientific discovery, imagining our species frontier, and expanding human inspiration are preserved. Few societies would deem as useless the body of knowledge and emotion evoked by the starry sky, but nowhere has it been established that we can expect to derive such sustenance from other inspirational sources in the current or future eras.

4.3. A Continuum of Inspiration

The beauty and inspiration of the night sky are likely to be underestimated or devalued by those who have not experienced it. For now, while such portals to the cosmos still exist, park rangers are making an effort to acquaint the public with the intellectual and emotional inspiration of the night sky. But how do astronomy educators make the case for seeking something most people do not know they are missing? Only a few accessible places still possess outstanding sky quality, and they are likely to be far from cities. Urban dwellers are still more likely to attend a local planetarium show than stargaze at a national park on a clear night.

While the educational potential of planetariums, especially the ability to visualize the latest understandings of astrophysics, is valuable, parks allow observation in a natural field setting, in contrast to a laboratory setting. These modes are complementary, with parks having a greater ability to kindle appreciation and inspiration and planetariums possessing the means to visualize, inspect, and manipulate.

A hybrid approach for imparting astronomical knowledge and inspiration would likely improve relevancy. Most of the public could be exposed to the night sky through planetariums, with urban astronomy clubs providing tangible experiences of the brighter astronomical objects and remote parks providing the deeper experience of a natural starry sky. Indeed, there are emerging programs that point toward this goal—the Astronomical Society of the Pacific’s Night Sky Network, which gives educational tools to amateur astronomers (Night Sky Network 2010); and the International Dark-Sky Association’s Dark Sky Park certification highlights areas where starry skies are protected and cherished (International Dark-Sky Association 2010). But a comprehensive plan, one that

emphasizes the critical role of inspiration, whether for scientific or poetic ends, has so far been neglected.

5. Conclusion

What makes astronomy one of the most provocative sciences is also its weakness. Astronomy brings the immensity of the universe into view and the depth of time into the present, but for more and more earthlings it is a remote science of questionable relevance. This trend has the potential to undermine public support and funding for astronomical exploration, impoverish the humanities, trammel the human spirit, and make the inhabitants of our planet more parochial amidst the astounding universe.

One should not assume that the transference of knowledge, especially comprehension detached from personal, genuine experiences, will result in inspiration, for inspiration usually *precedes* knowledge. Though there are more opportunities for humanity to learn from astronomical knowledge, we fear that opportunities for us to be inspired are diminishing. The full potential of astronomy is encumbered by the increasing elusiveness of the first-hand view of a natural dark night sky.

We are left with these questions on the future of astronomical inspiration: (1) Can inspiration be experienced vicariously, through the passion of a mentor or the story of a researchers quest, or is a more personal spark necessary to sustain interest and relevance? (2) Can knowledge be effectively learned if the fountain of discovery is long since dry? (3) What can be done to measure and improve the inspiration of astronomical phenomena?

It would be unrealistic to suggest the inspiration of a natural night sky be the only entry into the wonders of the universe. A continuum of inspiration is proposed, from planetariums to urban sidewalks to remote parks, balancing real experiences and virtual technologies. But we admonish readers that we are losing access to an essential ingredient for the long-term relevance of astronomy, the maintenance of the original wellspring of inspiration that has nourished so much scientific achievement and human expression—the *night sky scattered thick with stars*.

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