The Merry Dancers.

by C. Vispo

On February 19th, 1831, at around 8:30pm, somebody, possibly Principal J.W. Fairchild, stood looking at the night sky from near the Hudson Academy atop Prospect Hill. A half moon hung in the dark. Notebook in hand, our observer was aurora watching, and tonight he was not to be disappointed: "*Brilliant…in the west and south west, shooting up in spangles towards the zenith, very much like the process of crystallization beneath the solar microscope. These consistently faded, and were succeeded by others in different lines, exhibiting at times most of the colors of the rainbow. About half-past 9, similar appearances were seen in the east and south east, meeting those mentioned at the centre above, and forming an illuminated dome of spars and spangles, the most brilliant and beautiful ever beheld*."

On that same night, others were also peering upwards. Near Kinderhook, the aurora (aka Northern Lights) was "*uncommonly beautiful streaks of light*". At Albany, "*columns were observed shooting up to the zenith from the whole northern hemisphere*". In New York City, the aurora began to be visible around 9PM, and was "*peculiarly interesting… Some of the eastern coruscations were at times transiently curved, as though their middle parts were driven eastward by the impulse of the westerly breeze that was blowing at the time… A luminous band…passed near the moon, around which was one of the large haloes*." Sky watchers in Otsego, St. Lawrence, Oneida, Franklin, Herkimer, Westchester, and Kings Counties also logged awe-inspiring displays on that evening.

While particularly brilliant, this was no one-off: around the State, throughout the calendar, and across the years such night logs accumulated. These observations were not the incidental sightings of several people who happened to be out for a night-time ramble, they were mostly the duly-reported annotations of participants in one of the Country's earliest citizen-science efforts: the network of New York State academies, which Anna described in our previous article. These men (and they were almost all men) had been enlisted by the Regents to gather observations on the working of the weather and other celestial processes. While not institutions of the Regents, the Regents provided limited funding for the payment of teachers and other necessities, and the academies filed annual reports justifying and describing their efforts. Beginning in 1827, they were also asked to brave the night-time chill in order to note auroral activity.

At that time, scientists were only just beginning to turn an analytical eye to the weather, although the revolutionary idea of weather forecasting was still a couple of decades away. What the so-called Scientific Revolution had so far brought to meteorology was not its understanding, but rather the conviction that it could be understood. For generations, people had read portents into celestial events, deriving omens good or bad from the likes of haloes, meteors, eclipses, and auroras. Now 'science' was taking its turn. Observers were observing and patterns being sought. Who knew what mysterious threads might link aurora, magnetism, electricity, and weather? For example, based on observations made two months later to the day, a then-little-known teacher at the Albany Academy drafted a short note entitled "*On a disturbance of the Earth's magnetism, in connection with the appearance of an Aurora Borealis, as observed at Albany, April 19th, 1831*". The author was Joseph Henry and, in 1849, he was appointed the first Secretary of the nation's premier national scientific institution – the Smithsonian, whence he spearheaded meteorological studies, including the creation of the Country's first weather maps.

In good scientific form, the Regents tried to standardize the work of their collaborating observers so that the reports would be more comparable across geography and time. In 1833, they published aurora observation instructions assembled by the illustrious British Society for the Advancement of Science: during a one-hour observation period set to begin at 10PM, various characteristics were to be noted such as opacity, breadth, velocity relative to the stars, lateral motion, "defects in symmetry" and elevation with the aid of a theodolite. However, despite such analytical instructions, the aurora continued to simply enthrall. On January 14th, 1837, for example, a Kinderhook observer described the show as "*Brilliant, fantastic and very changeable; arcs, radiations, flashes and lurid banks*" On the third of September 1839, an Albany viewer noted "*Splendid; the entire heavens lighted up with long massy rays of a rich silver hue, radiating from the*

zenith, and forming a dome of magnificent proportions. Deep crimson mass in east and west alternately, which formed a striking contrast with the long lines of white light with which it at times mingled… Light so strong at times it cast shadows." On 18 November 1848, an observer in New York City reported, "*The Merry Dancers very numerous*."

Each of the Regents reports was filled with such notes, and a 19th-century compiler estimated that, at one academy or another, the aurora were noted on about 60 nights per year. While the Regents may have struggled to derive standardized information, it's clear that many had the opportunity to wax poetic about these light shows. Fast forward to the present, and how many of you have seen aurora from your backyards? Aside from any mystery about their origins and interconnections with other terrestrial and celestial phenomena (connections which are, by the way, still debated), one of the questions that taps most persistently at the skull of a modern reader of these accounts is, *Where are the aurora today?* The answer to that question tells us something about the aurora and perhaps something about ourselves.

One of the explanations for why we see fewer auroras today is, simply, that there are fewer. This is because the Sun is fickle and the poles have wanderlust. The current scientific explanation for the aurora is that a flow of protons and electrons emanating from the Sun as the solar wind interacts with the Earth's atmosphere, exciting atmospheric atoms which release light as they subsequently calm down. Because of the interactions with the Earth's magnetism, an auroral halo forms in a roughly 350-mile wide band about 10-20° from magnetic north (or south). The stronger the 'hose' of the solar wind, the brighter is that halo and the farther from the poles the auroras are visible. While some of the high 'floods' of solar wind are caused by unpredictable solar flares, others are associated with turbulence on the Sun's surface which, in turn, can be indexed by counting sun spots, those dark blemishes visible on the Sun's skin. More sun spots will, in general, mean more aurora. There is a continuous record of sun spot abundance going back into the 1700s, and so we have a way of numerically comparing then and now in terms of one force behind the aurora. Inspection of those records reveals a roughly eleven-year cycle in sunspots and shows that we are indeed on the waning arm of one of the weakest recorded sunspot cycles.

On top of this, we are getting farther from the magnetic North Pole. The magnetic North Pole and the rotational North Pole – the one heralded by the North Star - are not the same. Indeed, the point towards which your compass directs you has diverged from the rotational North Pole for all of its recorded history. Furthermore, the magnetic North Pole, to the chagrin of navigators, wanders. Today, it is moving towards Siberia at around 35 miles per year. In 1831, the year it was first pin-pointed, the magnetic pole lay at about 70° N, 96° W (a location in northern Canada some 1400 miles from the rotational North Pole and 2100 miles from us); today it is found at roughly 86° N, 159° W (a spot in the Arctic Ocean about 250 miles from the rotational North Pole and 5400 miles from us). The auroral halo has moved with it. Picture a classical monk with his tonsure of hair around a bald pate. With a good barber, the ring of hair will perfectly encircle the top of his head, and a fly sitting on either ear gets a roughly equal view of the furry higher reaches. Now suppose that, after a few glasses of wine, the barber is a bit off center - he keeps the radius of the hair ring constant, but tilts its center point to the left. The fly on the monk's left ear may then be brushing the hairs from its eyes, while the fly on the right ear may be convinced the monk is now bald. If we assume the ring of hair is the aurora, the monk's head is the globe, and we observers are flies, then we were the left-ear fly in the 19th century but are now heading towards being the right-ear fly. The auroral halo is receding from our view.

These celestial and geophysical processes probably account for much of the auroral drought at our latitudes, but we ourselves may also be contributing. Foremost amongst our own contributions is probably light pollution, the erasing of the nighttime sky by our ever-more powerful lights. In the Academy records, for example, Erasmus Hall, located near Prospect Park in what is today Brooklyn, provides some of the most vivid descriptions of the Northern Lights. One need only compare the candlepower of a mid-19th century gas street lamp (ca. 13 candlepower) with those of a modern street lamp (potentially measured in the 1000s) to understand that the neighborhood of Erasmus Hall was surely a darker place during that era. Such is true not only of city locations but also of more rural spots, where the light auras of nearby villages or cities, or of the commercial or residential cluster down the road tinge the nighttime sky and so can mask faint auroral glows.

Finally, while we can pin some of the blame for the apparent rarity of modern aurora on sun cycles, drifting poles, and light pollution, perhaps we are also short in the wonder that fuels observation. Those academicians, stamping their feet, clutching their pencils, and, no doubt, pulled by the tasks of the day ahead or behind, weren't just out to see a show, they were out to discover. They believed that through patient, coordinated observations, perhaps with compass (to detect auroral-induced magnetic variation) and theodolite in hand, they could start unraveling the aurora's secrets, revealing mysteries which had puzzled generations. Curiosity and the idea that new knowledge could be derived from the observations of the 'common person' was heady stuff and likely a potent spur for getting up from beside the fire. Imagine looking at the night sky and seeing more questions than answers; and imagine believing that some of those answers might be at your own finger tips. One of the greatest challenges to learning today is, I think, the perception that we know it all. We don't, but sometimes the enticing corners of unknown which can be illuminated by our own senses get buried beneath a dulling hubris.

It's unlikely that many of us who stay in the County during this upcoming December will see the aurora, and yet who cannot wish that their holidays might sparkle just a bit more given a visit from the Merry Dancers. We wish you all such a visit and, more than that, we hope that as you travel through the natural world in 2016, you have the health and peace of mind to really wonder.

Aurora Borealis (1865) by Frederic Church. While Church apparently based this image in part on the notes and sketches from an Arctic-exploring friend, he likely witnessed the aurora personally at times as well, perhaps even from the land around Olana. While a straightforward landscape depiction at one level, this painting is also believed to present an allegory for the culmination of the Civil War. Courtesy Wikipedia and Smithsonian Institution. Image in the public domain (https://en.wikipedia.org/wiki/Aurora_Borealis_%28painting%29#cite_note-3).