



episode 11 (2018 November) *Spectacles of Nature*

Heather: Hello everyone! Welcome to the eleventh episode of the RASC 150 History Podcast! Over much of the country it has turned cold, cloudy, and meteorologically mercurial, making observing, when possible, somewhat challenging. For those occasions when viewing the heavens is just not feasible, we can at least offer you the lesser astronomical entertainment of our RASC 150 podcasts. Those of you who insist on observing in frighteningly frigid conditions can draw on the conceptual warmth of the ideal winter mode for podcast listening, that is, with mulled cider in hand, near a comforting crackling fireplace [*sound of a fireplace*], a plate of gingersnaps within reach, and the usual cat modelling a furry doorstep warming itself nearby [*sound of a cat—Heather addresses it sotto voce*] *Ssssh! I thought you were asleep; we're recording! And you're supposed to be notional.* My name is Heather Laird, I am a Director of The Royal Astronomical Society of Canada, and my co-host is the RASC Archivist, Randall Rosenfeld. Say hello, Randall!

Randall: [*some mumbled greeting, or other*].

Heather: For this podcast we will be venturing conceptually outside, to witness astronomical entertainments much grander than mere podcasts, namely the astronomical spectacles of nature—phenomena such as phenomenal great comets, dramatic total solar eclipses, awe-inspiring meteor storms, impressive conjunctions, and coruscating auroral displays painting the skies.

It is characteristic for such displays to linger long afterwards in the memories of those fortunate enough to witness them. All of them are rare, and many are once-in-a-lifetime events. Even those phenomena such as solar eclipses, the most frequent among the astronomical rarities, exhibit considerable variation in their display. Total solar eclipses are *not* remembered as so many invariable iterations of the same thing, but rather as particular individual manifestations of the phenomenon; durations of the stages differ, colours of the features vary, and the

form of the corona can show much variation. There is always an element of chance which can cause surprise verging on awe, as for instance when the observed zenith hourly rate of a meteor shower soars impressively above predictions, or when there is a succession of striking fireballs, or even one sufficiently powerful one.

Randall: The astronomical spectacles of nature can also have lasting effects on the course of peoples' lives. Many astronomers, amateur and professional, attribute their interest in astronomy to seeing one of those phenomena.

Heather: Were ought we to start, then?

Randall: How about in the 14th century?

Heather: Oh that's good news! It will serve to reassure those of our loyal listeners who have been mildly perturbed that we have gone through nearly a year of podcast programming without once citing anything from the 14th century, that we are acutely aware of our regrettable oversight, and we will now endeavour to make amends. [*sound of a cat—Heather addresses it sotto voce*] *Ssssh! We're still recording, and you don't even know when the 14th century was!*

Randall: Nicole Oresme, who lived from 1320 to 1382, was a brilliant and productive researcher in astronomical and other learned disciplines of his time—in modern anachronistic terms we might call him both a mathematical physicist, and a cosmologist of high calibre. He was also a vigorous opponent of judicial astrology. In his *Treatise Concerning the Commensurability or Incommensurability of the Motions of the Heavens*, after quoting ancient authorities on the grandeur of the starry heavens, Oresme notes the lack of uniformity in the distribution of objects, and states that diversity more than uniformity is the source of beauty in the universe.

He is certainly of interest, but his idiom might take some adjusting to for some listeners: [Quote] “...*what could be a greater delight to souls, or more readily elevate the mind to divine things, than to contemplate the melodious music of the stars in heaven; to wonder at their brilliant dance which maintains, with varied turns, the appropriate rhythms by means of which the fabric of this world is regulated...and subjected to the band of celestial bodies which extend into eternity, for the perennial exercise of the human mind, a brilliant diversity of motions*

moving effortlessly with a certain regular inequality through the swiftest and most tranquil course. A spectacle, but as Cicero says, 'nothing can be more marvellous or more beautiful than this spectacle'. 'No sight...satisfies more, nothing is more beautiful or more excellent for the ingenuity and exercise of humankind' ...Seneca also says 'in order that you may know that nature wishes to be observed and not merely to be thought about, and see the place it has given us: it has put us in the center and made us part of it giving us a view of all the things around us...Now whether or not an irrational ratio is more noble than a rational one, an harmonious union of them is more excellent than a separate uniformity. Indeed, we see this in other things. Thus, a mixture of elements is better than the best element; the sky is more wonderful that it would otherwise be if the stars were distributed everywhere; the whole universe is more perfect because there are corruptible things—and even monsters—in it; a song with its consonances varied is sweeter than if it were constituted continually form the best consonance...' [close quote]. And, if you the listener be so inclined, you may perceive the contrast between Oresme's language and that which is more familiar to us, and the differences in worldview across six and a half centuries as a source of cultural beauty through diversity.

Heather: Speaking of contrasts, an amusing one is created through juxtaposing Oresme's praise of a non-uniform local universe, with Thomas Burnet's aesthetic preferences for a uniform universe, produced three centuries after Oresme: [quote] "Who can reckon up the Stars of the Galaxy, or direct us in the use of them? Of those few Stars that we enjoy, or that are visible to the Eye, there is not a tenth part that is really useful to Man, and no doubt if the principal end of them had been our pleasure or coveniency, they would have been put in some better order in respect of the Earth? They lie carelessly scattered, as if they had been sown in the Heaven, like Seed, by handfuls; and not by a skillful hand neither. What a beautiful Hemisphere they would have made, if they had been plac'd in rank and order, if they had been all disposed into regular figures and the little ones set with due regard to the greater, then all finish't and made up into one fair piece or great Composition, according to the rules of Art and Symmetry. What a surprizing beauty this would have been to the Inhabitants of the Earth? What a lovely Roof to our little World? This indeed might have given one some Temptation to have thought that they had been all made for us; but lest any such vain imagination

should now enter into our thoughts, Providence (besides more important Reasons) seems on purpose to have left them under that negligence or disorder which they appear to us” [close quote]. Mind you, read now, Burnet’s desire for a better-designed universe with uniform stars uniformly arranged is quite entertaining on its own, without the comparison to anyone else’s theories.

Randall: One of the truly rarer astronomical spectacles of nature are transits of Venus. Some at least of our listeners were among those fortunate enough to have witnessed one of both of the transits in 2004, and 2012. Aside from their rarity, they’re also unusual among grander astronomical spectacles in that they are visually less immediately arresting than things like total solar eclipses, meteor storms, or auroral displays. Much of the visual grandeur of the transits comes from the context we bring to our observing of them—in particular, knowing of their rarity, and even more, recalling their place in earlier attempts to accurately determine the cosmic scale of the universe, and the dramatic stories of those who set out to observe the transits.

The first person to have successfully predicted a transit of Venus, and observe it, was the twenty-one year old Jeremiah Horrocks, who won great posthumous fame for this double feat, and was equally distinguished for having penned what is probably the worst astronomical poetry of the 17th century. We won’t read any of that here, but it is only fair to warn you, that if Heather and I do not receive suitable seasonal tokens of your appreciation, we will indeed read that poetry on the next available podcast opportunity after Christmas.

We do deem it reasonable, from an astronomical history and heritage health and safety standpoint, to expose you to some of his prose.

In his *Venus on the Sun*, Horrocks wrote: [quote] *“Shortly after beginning the study of astronomy, when my mind turned to its practice, I computed ephemerides for several years from those Perpetual Tables of Lansberge...the very great imperfection of those tables being detected, persuaded me that the minds of mathematicians deserved more useful work. I therefore broke off the worthless calculations, subsequently investigating with my own eyes the positions of the stars in the sky itself...I prepared my mind for greater care in observing.*

Thus engaged, this most noble conjunction of Venus with the Sun first came to my attention...At 3:15 in the afternoon [of the 24th of November 1639 by the Julian Calendar], however, when I was first free to resume observation, the clouds, which had earlier advanced threateningly, being now completely dispersed, invited me, as if providentially, to the preferred favorable opportunity. I then beheld a most pleasing spectacle, and the object of so many wishes...Not doubting in the least that this was the shadow of Venus, I immediately prepared myself for attentive observation of it... my most esteemed associate in astronomy, W[illiam]. Crabtree, a man who has few superiors in the mathematical sciences...happily saw the most agreeable spectacle of Venus in the Sun. In delighted contemplation of it, barely in control of himself, he stood quietly looking for a long while, delighting in it, and scarcely confident enough of his own senses. For we astronomers have a certain feminine disposition, and immoderately delight in trifling things, which do not move others in the least. At this natural levity certainly those who wish, may safely smile, And I too, when I am present, and if it seems pleasing, assist in the jest and tale” [close quote].

Horrocks’ achievement was certainly familiar to those engaged in the colonial enterprise of transit observations in Canada in the years between the origin of the Society and our refounding in the wake of the 1874 transit of Venus—but that is another story.

Neither Horrocks, nor Crabtree’s interest in astronomy had been kindled by the transit of Venus, as they were already devoted to the science. Earlier we’d mentioned that it was not uncommon for astronomers to trace their interest in the science back to witnessing one of the grand shows staged by the heavens. And it is to several examples of that we now turn.

Heather: The period after the century of Horrocks and Burnet offers some fine examples. The total solar eclipse of the Sun of 1748 July 25 inspired more than a few of the major astronomers of the second half of the eighteenth century to become astronomers. The genial and competent fifth Astronomer Royal, the Rev’d Dr. Nevil Maskelyne, among the true heroes of the quest to find the longitude, was one such. To quote from his manuscript autobiographical account: “*From occasional discourses in the family, he became eager to see the effects of telescopes on the heavenly bodies, and to know more of the system of the universe.*

Observing the great eclipse of the sun in 1748 with the late Mr. Ayscough in an unusual manner by means of the sun's image projected through a telescope on a white screen in Camera obscura added fresh spur to his astronomical desires, and from this time he turned himself seriously & closely to the study of the two kindred sciences Optics & Astronomy, which he has pursued with unwearied diligence ever since” [close quote].

Another future notable astronomer inspired by the same eclipse was the admirable proto-feminist, spider-eater, and staunch adherent to atheism, Jérôme Lalande. His younger colleague Delambre in his memoir on Maskelyne, noted that: [quote] *“It is very remarkable that this eclipse [of 1748] produced the same effect on the mind of Lalande...and it may with truth be observed that no celestial phenomenon was ever more useful to science than this eclipse, which gave her two such very distinguished astronomers...”*. Lalande, could in fact claim to have been inspired by two grand astronomical spectacles. Quoting Delambre again: *“The comet of 1744, whose tail was one of the most remarkable ever observed, attracted his attention. He asked what held the stars in their places, and it was predicted that one day he would be a great astronomer. Matching his rhetoric, he had a passion for eloquence and appeared destined for the bar. The great eclipse of the Sun of the 25th of July 1748, which he observed with Father Béraud, his professor of mathematics at the Collège de Lyon, finally determined his choice in favour of astronomy. In order to give himself entirely to this new study without distraction, he wished to become a Jesuit” [close quote].*

Randall: In fact, there were at least three prominent astronomers of the Enlightenment inspired by one or both of those phenomena. For, according to Delambre: [quote] *“At fourteen years of age, Charles Messier had been keenly impressed by the spectacle then offered by one of the most beautiful comets he would ever observe; and four years later, he was not any less attentive to the great solar eclipse, which determined simultaneously the vocations of Lalande and Maskelyne. One same eclipse therefore wins for astronomy three very famous academicians, although each in a very different field”*. Clearly total solar eclipses and great comets bring good things.

What, then, is the RASC's tradition of encountering the Grand Astronomical spectacle's of nature? Do we too have a tradition?

Heather: Of course we do! [sound of a cat—Heather addresses it sotto voce] Sssh! I'm going to ignore you. Can't you find some notional catnip? At the meeting of the Society on 1892 February 9, it was reported that: [quote] "Mr. Miller, Mr. A. Elvins, Mr. A. Harvey, and the Chairman referred to the recent noteworthy conjunction of Jupiter and Venus, regretting that clouds obscured vision on the night of the 5th February, when the planets, had the sky been clear, would have appeared as a beautiful and most lustrous double-star. Mr. Miller stated that, with a sextant, he had made observations which proved that Venus was moving over about one degree of arc per day. The magnificent spectacle afforded by the apparent near approach of the new Moon to the planets on the night of Sunday, the 31st of January, was described by several members, some of them mentioning the fact that it was observed by thousands of church-goers, and was noticed in the newspapers of the following day" [close quote].

It wasn't just notable planetary conjunctions which were seen as among the spectacles of nature, some planets when favourably placed attracted similar language. On December 30th of 1890, one of our honorary members told the Society that: [quote] "*Among the numerous celestial objects which claim the attention of astronomers, none possesses a greater charm than the planet Saturn. Surrounded by its magnificent and graceful rings and attended by its Family of eight satellites, it presents in the field of view of a powerful telescope a gorgeous spectacle, one never to be forgotten*" [close quote].

Randall: Meteor storms have come up earlier. One of our members recalled seeing the Great Leonid meteor storm of 1832. A modern estimated peak zenith hourly rate for that storm is 2,000 meteors—impressive, but less so than that of the same even the year latter, with a peak zenith hourly rate of 60,000 meteors! AT the Society meeting of 1897 March 30, we can read that: [quote] "Dr. Meredith then proceeded :—I am old enough, I do not say fortunately old enough, to remember distinctly the brilliant display of meteors in Ireland in November, 1832, a sight never to be forgotten. I was then at Castlenock School, a large private school in the neighbourhood of Dublin, just outside the Phoenix Park...Lucky it was for me that we boys had every evening to run across the open from the school room to the supper room, as otherwise I should probably have altogether missed seeing this magnificent spectacle, for it was on the occasion of one of these evening transits, shortly after eight o'clock, that we boys, as we came "bounding out of school,"

were amazed and awe struck by the extraordinary spectacle which the heavens presented. It was as if all the stars had become suddenly unfixed and were rushing pell mell to the Earth, leaving the firmament an empty void. It looked indeed like a shower of fiery snow flakes, so thickly and yet so gently did the falling stars seem to come down” [close quote].

Lunar eclipses of all kinds, much more frequent than total solar eclipses, could attract some of the language associated with the rarer spectacles. Much depended on how individual observers were affected by what they saw, and it’s undeniable that strong emotional responses and aesthetic reactions were part of the experience of observing scientific events. At the meeting of 1895 March 19, it was reported that: [quote] “Mr. Arthur Harvey, who presented a coloured drawing of the eclipsed Moon, said :—“ The eclipse was punctually on time, though no eye could see to the minute when the Moon swept into the penumbra, which has no definite edge. As this light shade covered the maria it caused a smoky look, which prepared the observer for the appearance of the shadow proper. This was at first of the colour of soot, a simple blackness, enough to blot out the lunar features, though some of the bright spots were visible where the gloom had completely covered them. When about a third of the surface was covered by the shadow proper, I was called away, and only returned to my post when totality had set in. A more wonderfully beautiful sight could not be imagined. The upper edge of the Moon was of a beautiful blue, below and on each side was the loveliest tint of rose, then followed a yellow, a copper colour, the darkest parts of which were bronze. Though several eclipses recur to memory, none so beautiful is among them. The colours of the sunset were in a manner reproduced...” [close quote].

Heather: The astronomical spectacle to attract the most frequent attention in the early Society, to judge by our surviving records, is auroral displays. As Randall said above, emotional and aesthetic responses shine through the scientific reports.

Andrew Elvins, one of the original founders of what became the RASC, reported at the meeting on 1892 July 26, that: [quote] “Since our last meeting we have had two aurorae, both very instructive, though the second was far more grand and beautiful than the first...The most brilliant display of aurora which I have seen since 1872, was visible on the 16th of July. I noticed it first about 10 p.m., as a broad, hazy stream of auroral light in the East, but it soon crossed the zenith and extended to the

West, where it took on a purplish he, the Eastern end remaining whitish but tinged here and there with green. When the spectroscope was pointed toward the West, the spectrum showed the two lines observed on the 13th, and also another far in the purple. While engaged with the spectrum the whole Northern heavens suddenly lighted up and, for a few minutes, presented a most gorgeous spectacle. It seemed as if the hitherto clear sky had become covered with patches of light cloud invisible except when, with a sort of electrical scintillation, they were, as if by sheet lightning, splendidly illumined by auroral light passing in rapidly succeeding rushes, or waves, or pulsations, from the North far towards the South. The Western sky was decidedly of a reddish-purple hue, while that of the East was more greenish white, though sometimes a reddish glow was visible even there. A corona formed near Vega, and all the rays radiated from that point” [quote]. It is, of course, a good thing that the reports are not dispassionately stripped of the full range of human responses of the people who made them, for the observers are human, after all.

Randall: A continuity can be found in our responses to the grand spectacles of astronomy, across the 150 years of the Society’s existence. The responses are a compound of intellectual, emotional, and aesthetic factors, and it is that which makes the phenomena good entrainment and instructive platforms for outreach, as well as a scientific opportunity. This is well known to most astronomical organizations and institutions with combined education and research mandates. But there are questions we should all be asking ourselves: “How do we best balance our responsibilities to doing science, to ourselves, and to the public when we present ourselves as portals to these phenomena?”. And, “Are there limits to what advocates of astronomy can expect in the wake of major, and rare celestial events?”.

Heather: Thanks to everyone who tuned in, and we hope you enjoyed this podcast. If you have any questions, please visit www.rasc.ca/rasc-2018-podcasts for contact details.

I have a hunch that our final official podcast in this series, in which we look at the RASC’s practice of cultural astronomy, will succeed this one. Stay tuned, because there may be another one snuck in before then.

Our sound engineer is Chelsea Body, and our theme music is by Eric Svilpis.