image: *www.nasa.gov/content/hubble-sees-a-smiling-len*

episode 6 (2018 June) *Mapping the Heavens*

Heather: Hello everyone! Welcome to episode six of the RASC 150 History Podcast, in which we follow the contours of where the RASC has wandered purposefully, or otherwise over the past 150 years. 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: *[in one of those voices]* "Welcome to the sixth episode of the RASC Horryble Hystories…"…oh, sorry, wrong script! *[some discreet shuffling of papers]*…er, hello.

Heather: Curiosity about how the universe works is essential to who we are. We assume that you've tuned in to this podcast because you're curious about the evolution of a part of the story of the RASC, a rather modest part of the universe indeed. The topic of this podcast is *Mapping the Heavens*—well, not *all* mapping of the heavens, but rather several aspects of the cultural context, use, and production of cartographic representations of the sky in the RASC. We should define a few terms before we go on—and who knows, you might even be able to use these in a pub quiz, prior to the last call, before the heat death of the universe.

Randall: Our first term is "Uranography", which the OED defines as: [*quote*] "The branch of astronomy concerned with the description and mapping of the stars or the heavens; a description or delineation of these" [*close quote*]. The term goes back to the seventeenth century.

Heather: And our second term is "Astrometry", which can be defined as "that department of astronomy bearing upon the careful and precise measurement of celestial objects in the sky". It is easy to see the relationship between the activities of uranography, and astrometry, for accurate positions of celestial objects are needed in order to place those objects on celestial maps.

Randall: It is probably fair to say that in representing the heavens symbolically, we are mapping ourselves onto the sky. The names we assign to what we see up there—from Greco-Roman constellations and asterisms, to medieval Arabic star names in Latin form, to alpha-numerical designations for objects in modern catalogues—are names we assign based on our systems of meaning, however empirically derived.

Heather: The names and their assigned meanings run deeper than the present. And it's a bit like an archaeological site—actually, it's a lot like an archaeological site, with objects recovered from different layers, with their time of deposition partially readable from the stratigraphy. If Alex Gurshtein is even partly right, some of our conceptual groupings of stars predate the ancient languages we can recover. Go to any astronomical event today, and the constellation names you'll hear will be from a 1920s reform of a classical heritage which didn't stop developing till the middle of the eighteenth century; the principal naked-eye stars will be referred to by Latin versions of medieval Arabic names; major lunar features will be called by names assigned in the seventeenth century; the brighter nebulae and star clusters will be identified by eighteenth-century catalogue numbers; and many of the dimmer nebulae will be identified by late-nineteenth and early-twentieth century catalogue names. One of the attractions of current astronomical nomenclature is its cumulatively heterogenous nature.

Randall: It's been recognized since at least the eighteenth century that science proceeds most efficiently in an environment with a commonly agreed upon vocabulary. For each of us, the organization of knowledge we possess and employ is a combination of common disciplinary practice, and private experience, of formal and informal maps. We use printed and electronic star maps with symbolic representations of celestial objects plotted according to the best positional data, and names of objects approved by the International Astronomical Union, yet we also carry in our heads private cognitive maps of the discipline, star maps, and images of objects we have seen, sometimes identified by informal names. Both formal and informal maps are our guideposts to the stars.

Heather: The classical constellations are among the longest-lived elements in our maps of the heavens. A hundred and fifty years ago, at the time the Society was founded, one could choose between celestial atlases with, and celestial atlases

without fully realized constellation figures, but in both cases constellations were used to organize the contents of the sky laid out on the vault of heaven. If one sought diligently enough, a few celestial atlases without any constellation figures at all could be found, but the bounds of the constellations were still used in the accompanying texts as spatial containers for the “fixed stars”, and in experienced users’ internal cognitive maps. The cultural prestige of the classical heritage was still to be felt. And many astronomers saw Greek astronomy as the origin, or one of the origins, of the “progress” of astronomy which was still unfolding. *The* great name in Greek mathematical astronomy, Claudius Ptolemy, had attributed to him in the tenth century a memorable epigram illustrating a very personal relationship to the map of the heavens: [*quote*] “I know that I am mortal, a creature of a day; but when I search into the multitudinous revolving spirals of the stars my feet no longer rest on the Earth, but, standing by Zeus himself, I take my fill of ambrosia, the food of the gods” [*close quote*].

Randall: Ptolemy, in his most famous authentic work, the *Syntaxis* or *Almagest*, when discussing celestial globes, emphasized the practical convenience of the use of the constellations on representations of the sky: [*quote*] "As for the configurations of the shapes of the individual constellations, we make them as simple as possible, connecting the stars within the same figure only by lines, which moreover should not be very different in colour from the general background of the globe. The purpose of this is, [on the one hand], not to lose the advantages of this kind of pictorial description, and [on the other] not to destroy the resemblance of the image to the original by applying a variety of colours, but rather to make it easy for us to remember and compare when we actually come to examine [the starry heaven], since we will be accustomed to the unadorned appearance of the stars in their representation on the globe too" [*end quote*]. It would appear that his uranographic successors of the sixteenth to the nineteenth century were not so interested in keeping to simple, unadorned constellation figures. And I for one am glad they weren’t.

Heather: The first members of our Society were inheritors of a European uranography with a strong classical veneer. One of our prized early possessions is the oldest complete celestial atlas in our collections, Alexander Jamison’s late-Georgian *Celestial Atlas* of 1822. It wasn’t the only copy in the young Dominion in 1868. It’s a very charming book, but also a practical one. Its imagery was

representative of influences forming the uranographic vision of our Society's founders. Even if you were a tailor by profession and astronomer by avocation, with little command of Latin and even less of Greek, you could still partake of an aspect of classical culture through absorbing these images. And seal the Society acquired in 1905, with its personification of the classical Muse Urania against a suggestion of stars, is also very much a product of that tradition.

Randall: A century before Andrew Elvins and his colleagues founded what became the RASC, another Georgian astronomical book was published, in which the mathematical practitioner John Hill gave a common-sense justification of the persistence of classical figures on celestial maps. His account is not dissimilar in part to Ptolemy's, and still makes eminent sense today: [*quote*]
"CONSTELLATIONS. Certain imaginary figures of birds, beasts, fishes, and the like in the heavens, under the out-lines of which astronomers have collected certain stars, in order to the speaking regularly of them with regard to their places in the heavens. ¶The fixed stars, although they are not by a great deal so numerous as might naturally appear to an unexperienced eye, are yet so many and so irregular in their situation, that it would be impossible to treat of them without some sort of arrangement; and by disposing them in this manner, in some part of the figure of an animal, or whatsoever else, they may be regularly and intelligibly spoken of, with respect to their situations of places, in regard to one another, and be treated of with the greater facility. ¶Among other figures, the reverence of early times for certain persons, whom enthusiasm had spoken of as carried up into heaven, led them to ordain their representations for the receiving of certain stars: animals, and even things inanimate, which the fabulous stories of those times had afterwards supposed removed into the same regions, on particular occasions, became added to those, and, by degrees, the heavens were fully stored with these imaginary signs and lineaments. ¶It was very early in the study of astronomy, that the fixed stars were distributed into six classes...and soon after catalogues were made of them...and in these catalogues their situation in longitude and latitude was laid down. It is owing to these catalogues that we can apply the ancient observations to use, by comparing them with the modern; and this would have been impossible without the assistance of the prior arrangement of the stars into constellations; since without this it would have been impossible for them to have spoken of them intelligibly" [*close quote*].

Heather: The most notable early uranographic undertaking of the RASC was the star maps in the first editions of the *Observer's Handbook.* In the *editio princeps* from 1907 and its immediate successor of 1908, the star maps are nicked (with permission!) from another publication. The constellation figures are of the stick variety, which might have earned Ptolemy's approval for simplicity, but the maps were small, and without coordinates. They were not displeasing in appearance—indeed, they're reminiscent of the monthly star charts published in *SkyNews* today, but at a much reduced scale. This style continued from 1909 to the beginning of 1911, the period when a diminished version of the *Handbook* appeared serially in successive numbers of the *Journal of the Royal Astronomical Society of Canada*.

Randall: Even though the star charts in the *Handbook* from those years were entirely derivative, someone had to fulfil the role of "designer" to redraw the images. That person was certainly a competent draughtsman, but no one was identified in print as the artist. It should be noted that many scientific institutions, such as observatories and university departments, had technical artists on staff, and that scientists themselves, including astronomers, frequently had some experience in technical drawing, even if it was only from their student days in geometry and spherical trigonometry classes.

Heather: When the publication of a separate *Handbook* resumed in 1912, something good happened uranographically speaking; the RASC commissioned its own star charts for the *Handbook*. These were bound in as a detachable set of four double-page mag. 4 star charts down to -40° δ, with lines of right ascension and declination. They were spacious enough to make customization easy, through adding notes or plotting objects of interest to the observer, and the provision of a coordinate grid encouraged the latter. It is tempting to refer to this as the RASC atlas. In addition to naked-eye stars, the charts also included many of the Messier objects, in their historic first appearance in the *Handbook*.

Randall: The 1915 *Handbook* replaced the set of a round circumpolar and square charts, with several circular seasonal charts. Unlike the earlier charts, those of 1915 are signed "RKY", the initials of C.A. Chant's colleague, R.K. Young. They are less competently drawn than the earlier charts, which were again published in the *Handbook* till 1917, when they were apparently cut as an economy measure. It is quite possible that C.A. Chant was the designer of the mag. 4 star charts, and the copyist of the 1907-1911 charts, given that he was editor of the *Handbook*, and

didn’t provide an artist’s attribution. If so, he was a respectable uranographer on a small scale.

Heather: In the same year that the variant charts appeared in the *Observer’s Handbook*, Young published a mag. 5 atlas down to -30° δ in the *Journal of the Royal Astronomical Society of Canada*, which he called a gnomonic star atlas. A gnomonic star atlas uses a map projection which displays all great circles as straight lines. Young explained its use: [*quote*] “The following set of thirteen maps is intended to facilitate the observation of meteors and the plotting of their paths” [*close quote*]. It was a much more ambitious piece of uranography than his maps for the *Handbook*. Equally ambitious, but in a different way, is the project reported in the paper preceding Young’s gnomonic atlas. In that contribution, RASC member H.B. Collier reports on "How I Sculptured the Moon". He had produced a 3-D, accurately contoured sculptural representation of the visible face of the Moon. Judging by his photographs, it was a most impressive piece of work. We don’t know what became of it; had it survived, it would be exactly the sort of artifact one would wish for our Archives.

Randall: Speaking of Collier’s selenographical project from 1915, in the earlier part of the twentieth century amateurs were occasionally encouraged to try their hands at constructing their own star maps in one of the then common map projections, preferably using their own astrometric observations. The Abbé Moreux gave instructions for how to go about the process in at least one of his many observing manuals. The latest publication aimed at amateurs which discusses the techniques for the practice of uranography is Dr. Tricker’s attractive *The Path of the Planets*, dating from the years of the Apollo missions. The usual stated goal of the exercise was to equip amateurs with some practical experience of what went into the construction of celestial maps. The exercise was also often part of rudimentary undergraduate astronomy courses at the beginning of the twentieth century. Many of us could doubtless benefit from trying it now, in this age of easy computer-aided astronomy. Of course, there are amateurs who can now write their own planetarium programs, which is the same sort of thing using modern technology.

I know of no amateur RASC members who took up the challenge of becoming uranographers in the first half of the twentieth century, but that does not mean that there weren’t any. In a related line of endeavour, Geoff Gaherty, whom we mentioned in our last episode, did compile a map of Martian albedo features around 1960.

Heather: By that time many amateurs had been venturing into astrophotography for decades. The most notable attempt to make a photographic map of the sky by an amateur RASC member is Damien Lemay's atlas of the sky from -40° to +90° declination, done with a modest 140-mm Schmidt camera, in the years from 1977 to 1985. This, of course, was when film was in the ascendancy, and there were no consumer computers, when undertaking such a project was considerably more difficult than it would be now. And the sessions during cold Rimouski winters could be brutal. Damien persevered, and finished the project, for which he was awarded the Society's Chant medal in 1987, our highest award for significant amateur achievement. While the Society was impressed by what he'd accomplished, he himself was ready to point out its shortcomings.

He notes in retrospect that: [*quote*] "The 916 pictures were printed on 8x10 inch glossy paper. To me at least, glossy seems to enhance resolution. The limiting magnitude is around 13-14, and each frame covers an area approximately 8.6° x 5.9°.They are not all of the same quality, and there are many reasons for this.

When I began the project, I made test with the black and white films then readily available, and decided to go with Kodak Plus-X, which showed smaller grains capable of resolving close stars better than other films. But, in retrospect, that was not a good choice, because its sensitivity is too different compared to human eyes, and it is also very poor in the red, thus being inefficient with nebulas emitting the important wavelength of H-alpha.

My main instrument at that time was a Dynamax-8 (Schmidt Cassegrain with optics similar to the Celestron 8, but poorer mechanics), and the 140-mm Schmidt Camera was mounted piggy-back. Of course the mount was not GOTO, and aiming was done manually. Because of the shaky set up and various mistakes, many pictures are not well centered on the target fields.

Such a Schmidt camera is prone to generate scratches because of the way the film was loaded and unloaded from the camera, so there are many. Also, some stars are actually specs of dust, and accidental warping of the negative generated what looks like crescents".

Well, Damien's entitled to make those comments, but as far as we're concerned, what he accomplished remains impressive. And it's something neither Randall nor I can lay claim to. If you're interested in viewing it, a digitized version is viewable at www.rasc.ca/ap-introduction.

Randall: We earlier mentioned that each of us carries in our heads private cognitive maps of the sky. The most spectacular example I know of are the memory maps of the stars in other galaxies used by the Rev'd Dr. Robert Evans, one of our honorary members, and the person holding the personal record for most super-nova discoveries made at the eyepiece. Rev'd Evans had memorized the appearance of more than 1000 galaxies and adjacent star fields down to the 15th magnitude. Without the use of printed or electronic star atlases, he could locate and examine galaxy after galaxy at a rate of about one a minute. That ability certainly came in use when discovering extra-galactic super novae with 10- to 16-inch backyard telescopes! Needless to say, his is an observational feat much beyond my more limited abilities. But, it is something to which one can aspire, even if only in a very limited way.

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.

Our next podcast is scheduled for a month from now, and is on the traditions of amateur telescope making within the RASC, and what happened to them.

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